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(PELECYPODA)

(PLATES 1-10; TEXT-FIGURES 1-78)

BY

TRON SOOT-RYEN

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TRON SOOT-RYEN

Director of Tromsø Museum, Tromsø, Norway
Research Associate, Allan Hancock Foundation

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A REPORT ON THE FAMILY MYTILIDAE
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PREFACE

During the cruises of the *Velero III* and *Velero IV* from 1931 to the present year, a very valuable collection of mollusks has been accumulated in the Allan Hancock Foundation, the major part having been collected between Los Angeles and northern Peru and the Galapagos Islands, regions from which large collections are very scarce. Fortunately the larger part of the samples are preserved in alcohol and can be used for the study of the soft parts of the mollusks, and thus are far more useful than dried specimens only. The collection in the Allan Hancock Foundation is undoubtedly the richest and most valuable known from the regions investigated, and will add considerably to our knowledge of the molluscan fauna of the Pacific coast of America when it is properly studied. It is, therefore, to be hoped that trained specialists can work up this material as quickly as possible.

The present paper deals with the family Mytilidae found along the Pacific coasts of America south of Oregon, though a few specimens from Oregon, of species also occurring farther south, are included in the lists of the material. It has been possible to make a survey of the soft parts of the species and to give drawings of the mantle and other parts easily visible from the outside, and of details of hinges and muscle scars of the valves. Nearly all species are also represented by photographs on the accompanying plates. Four species are considered to be undescribed and several changes were found to be necessary in the generic placement of the species and in the general nomenclature. There might, however, still be a few unrecognized species of mytilids along the Pacific coast of America. I am not satisfied with the treatment of genera such as *Brachidontes, Hormomya, Crenella,* and *Modiolus,* and I believe that new material and a careful study of these groups, which is highly needed, is necessary before doubtful questions can be satisfactorily settled.

In an appendix is a list of all samples in the collection, arranged from north to south. The list of references is not intended to constitute a complete list of literature for this region but gives only those titles to which reference has been made.

Science will always be indebted to Captain Allan Hancock, whose interest in marine research has made the accumulation of this rich material possible.

Personally I wish to give my heartiest thanks to Captain Allan Hancock and to the Research Committee of the Allan Hancock Foundation for giving me the opportunity to work on this material as a Research Associate of the Foundation. I also wish to express my warmest thanks to Dr. Norman T. Mattox, who has helped me in many ways and who has taken the trouble to read the manuscript and correct the language. I am especially indebted to Mrs. Dorothy M. Halmos, librarian of the Hancock Library, who has brought the manuscript to a form corresponding to the other papers in this series, checked the names and references, and smoothed out the language. The drawings accompanying this paper have been carefully executed by the staff artist, Mr. Gaylen C. Hansen, who has shown a great interest in this difficult and time consuming work, for which I am very thankful. The photographs for the plates have been made by the staff photographer, Mr. Roy V. George.

I am indebted to many scientists for the use of collections in their care, for comparison and for loan of specimens, some of which are reproduced in the plates, and I wish here to express my gratitude to Dr. William J. Clench, Museum of Comparative Zoology, Cambridge, Mass.; Dr. Harald A. Rehder, U. S. National Museum, Washington, D. C.; Dr. Leo G. Hertlein, California Academy of Sciences, San Francisco; Dr. A. Myra Keen, Stanford University, Palo Alto; Dr. S. Stillman Berry, Redlands; Dr. Heinz A. Löwenstam, California Institute of Technology, Pasadena; Dr. Howard Hill, Los Angeles County Museum, Los Angeles; Mr. E. P. Chace, San Diego Museum of Natural History; Mr. John Q. Burch, Los Angeles; and I am especially indebted to Mr. John E. Fitch, California Department of Fish and Game, San Pedro, for bringing me many living specimens or specimens preserved in alcohol, for study.

INTRODUCTION

It is desirable to start with a diagnosis of the family Mytilidae, though only a few species from a limited area are treated in this paper.

"Shell equivalve, generally very inequilateral with prosogyre umbones near the anterior end; ligament elongate, deep seated, generally on nymphae, the inner resilial part typically connected with the nymphae by a calcified white ridge. Shell surface showing three areas: (1) the anterior area, the lunule, more or less distinctly circumscribed, often with radiating sculpture and dysodont teeth on the inner margin; (2) the median part, generally glossy and rarely with radiating sculpture; and (3) the posterior part often strongly sculptured or set off by a different color or by a keel. Shell ordinarily with the interior layer margaritaceous. Periostracum strong, sometimes with hairlike protuberances or with incrustations. Prodissoconch with provinculum, which persists in some smaller species. Mantle lobes united below the anal siphonal opening, branchial opening confluent with the pedal opening, posterior part of mantle edges often pigmented and furnished with papillae. Pallial line simple or with a shallow posterior concavity. Anterior adductor muscle smaller than the posterior one, sometimes obsolete in adult shells. Anterior byssus-retractor small, fastened before or behind the umbones. Posterior retractor is generally confluent with the posterior adductor. Foot finger-shaped with a ventral furrow, byssal gland behind the foot functional in most of the species. Gills filibranch; ventricle embracing the rectum, monoecious. Marine; a few species in brackish or fresh water."

Generally, species of the family Mytilidae are easily recognized as members of the family by the form, sculpture, hinge, and muscle scars. Some small smooth species have a transverse striation on the dorsal hinge margin like that found in the family Philobryidae, but the shell is not pitted by the fine tubules typical of the shells of the latter family.

It is difficult to indicate satisfactory characters for the separation of the family Modiolopsidae (fossil Ordovicium to Devonian) and the family Mytilidae, which reaches back in time to Devonian. The most logical explanation is that the Mytilidae form a continuation of some branch of the Modiolopsidae. The Mytilidae have generally been divided in groups according to the outer shape of the valves. Species with terminal or nearly terminal umbones, the mytiliform species, have been placed in the genus *Mytilus,* while species with subterminal umbones with a distinct anterior margin, the modioliform species, have been named *Modiolus* or

Volsella. Many species, however, have been placed in one of these genera by some authors and in the other genus by other authors, indicating that the outer form alone is of minor systematic value. The elongate boring forms with parallel dorsal and ventral margins and subterminal umbones were placed in the genus *Lithophaga,* though several of these species have been considered to be *Modiolus* by some authors.

The species with pronounced anterior and posterior radiating sculpture separated by a smooth central part, the *Musculus*-group, complete the four major groups according to the shell outline and sculpture characters, which have been used for classification of the mytilids. When the genus *Brachidontes* is added for the species with radiating sculpture over the whole outer surface, and the three genera *Idasola, Dacrydium,* and *Crenella* for the minute more aberrant species, the list is complete for the genera used by Thiele (1935) for all recent species of the family Mytilidae. Except for the last three mentioned, there have always been difficulties in the allocation of many species to the proper genera. The differences in opinion have been caused partly by the vaguely defined or circumscribed genera and partly by the idea that all species should be placed in the few "old" genera. During the years several supraspecific categories have been named, but ordinarily they have been considered of subgeneric rank and placed within the broad limits of the larger genera, thus indicating close relationship based on external characters of questionable value. One thing seems certain, the system of the Mytilidae has not been synthetized from small clearly circumscribed units, but was built up by forcing species of apparently very different origin into large groups of superficial similarity.

The supraspecific groups should be built up and circumscribed in the same way as is used for a species concept based on different populations. As many characters as possible of the shell and animal should be studied, also the distribution and if possible the history of the species considered, when arranging them into supraspecific groups. If there are doubts as to whether a species really belongs to a group or not, it is safest and most correct to keep it apart until the right systematic position can be clearly shown. If there are doubts about the relationship of several supraspecific groups, it is safer not to press them into one large genus for the sake of simplicity, but to keep them apart until this relationship can be proved or disproved. The same idea should be applied to species. If specimens from one geographical area are supposed only doubtfully to be identical with a species from another area, it is safer to use a special specific name for them until otherwise proved. The "new" species will naturally be

placed in the supraspecific group containing the "old" species and in due time the whole group will be revised on the basis of new facts. A wrong determination or allocation is the cause of many a too hastily made hypothesis concerning zoogeography or geological history.

These ideas seem to be those of a "splitter," but sound "splitting" is far better than conservative "lumping," and can bring out new useful information of various kinds, especially on the systematics of any particular group.

When the knowledge of a family is insufficient, usually many species are described and placed in different genera. As knowledge increases, there will be fewer species but more subspecies, fewer genera but more subgenera. The breaking down of vaguely circumscribed groups is necessary for the building up of a more natural system based on increasing knowledge.

There is still another advantage with small species-groups. If a species is listed as a *Mytilus* or a *Modiolus* with its specific name from a certain region, or a certain fossiliferous layer, it tells us very little. But if the narrower group, used either as genus or subgenus, is listed, even without a specific name, it tells us much more about the characteristics of the species, the past and recent distribution of the group, and makes it possible to use the record to add new facts to the picture of the whole group. Nearly all species of mytilids, at least the littoral species, are variable in outline and color. As most of the species described hitherto are characterized mainly by these variable features, several of them are nearly impossible to recognize and many have to be considered synonymous.

The first real attempt to arrange subgeneric groups of *Mytilus s. lat.* and *Modiolus s. lat.* was made by von Ihering (1900) in his studies "On the South American species of Mytilidae." Ihering had many good ideas, but he used mainly the form and the sculpture and the more superficial characters, and used the two "old" genera in a very broad sense. The species he treated were those found on the east coast of South America and some of his interpretations certainly are wrong.

Jukes-Browne (1905) made a very valuable review of the mytilid genera. He separated *Brachidontes* Swainson as a generic unit, but continued to use the four "old" genera for most of the other species. His arrangement of the subgeneric groups and his diagnoses of them, however, laid a solid foundation for later studies of the family.

Lamy's (1936-37) extensive paper on the recent mytilids of the Muséum National d'Histoire Naturelle de Paris is the only modern revision of most of the species belonging to this family. He recognized

ten different genera, including *Septifer* Recluz, *Arcoperna* Conrad, and *Adula* Adams. *Idasola* is included in or made a synonym of *Adula.* Lamy's work is very valuable, as he has made a thorough study of the synonymy of most of the species and also mentioned species not preserved in the Paris museum. Unfortunately he did not give diagnoses of the various species and the soft parts were not taken into consideration. Some of his conclusions may be wrong and some of his names not valid, but the vast amount of knowledge presented through this paper will be of everlasting value to students.

Cox (1937) has written a very interesting paper on the Jurassic mytilids with general considerations which should be read by students working on the recent material. He describes *Falcimytilus* as a subgenus of *Mytilus.* This group consists of species with terminal umbones but without lunular grooves or teeth. Even if they should be the ancestors of *Mytilus s. l.,* I believe *Falcimytilus* should be given generic rank.

Newell (1942) has treated the late Palaeozoic Mytilacea mainly on American material. His extensive discussion of the shell characters and the origin and evolution of Mytilacea is very useful and interesting. He describes the genus *Promytilus* and the genus *Volsellina* for mytiliform and modioliform late Palaeozoic mytilids respectively. Unfortunately the hinge and the muscle scars are not described.

The anatomy of several mytilids has been extensively treated by List (1902), Pelseneer (1911), and White (1937), and notes about the anatomy of different species can also be found scattered in the literature.

What are the characters which can be used in the classification of the variable mytilid species? As the major part of the mytilids have anteriorly placed umbones and are rather alike in form, this resemblance is not necessarily a criterion for the closer relationship of similar appearing species. The same form could easily have been acquired by different evolutionary lines, but it must be possible to prove or disprove this by a closer study of other characters and especially by following these characters through the fossil forms. Unfortunately very few characters are preserved in fossils and our knowledge of most of the recent species is still poor. It is, therefore, extremely difficult to tell which characters are more important than others and how the various species groups can be placed in relationship to each other. In this paper, therefore, many small groups are treated as genera; they probably will find their proper places in the system in the future.

The characters used for classification should, as far as possible, be taken from the shell and from easily visible parts of the anatomy, such as the mantle margin, foot, byssus, etc. One character which is supposed to be

of special importance is the retractor muscles of the foot and byssus. These muscles, which carry the visceral mass and can contract it against the shell and move the foot, should certainly be the most important ones for bivalves as well as for univalves. Whatever the origin of the pelecypods may have been, as a larval partial duplication from a gastropod origin or directly from the hypothetical ancestors of the mollusks, retractor muscles must have been the primary muscles of the animal. The adductors, usually the strongest muscles of an ordinary bivalve, seem to be enlarged parts of the muscles fastening the mantle to the shell. The position of the retractor of the foot compared to the posterior retractor of the byssus, and the form and placement of the anterior retractor in regard to the umbo, give valuable clues for classification (cfr. text-fig. 15).

The shell surface of most of the mytilid species is divided more or less distinctly into three areas, either by different sculpture or coloring. The anterior part, the lunule, usually is radiately ribbed, grooved, or striated, the grooves often forming teeth on the anterior margin; or the lunule is turned inwards so that the ridges form tooth-like thickened parts with corresponding grooves in the opposite valve. Sometimes a lunule is seen as a duller part of the periostracum (cfr. text-fig. 47), but often it is not separable from the rest of the shell. The median part generally is smooth and furnished with a more shining periostracum than the rest of the shell. The posterior part, usually bordered by a more or less distinct keel from the umbones to the posteroventral angle, is more heavily sculptured, has a different color, or hairy periostracum, or differs otherwise from the rest of the shell. The margins may be smooth or crenulated more or less extensively, generally in accordance with the sculpture. Several species have margins partly crenulated when young but smooth when full grown. The ligament is deep-set and a real escutcheon is not developed. The ligament is supported by a sometimes solid nymphae and the lower or ventral fibrous part, the resilial part, furnished with calcareous needles, is fastened to a ridge, here named the resilial ridge, which is white and of a quite different consistency than the rest of the valves (cfr. Pl. 5, fig. 23). This ridge continues posteriorly to the dorsal margin and forms one of the best characteristics of the family Mytilidae.

The mantle is usually separated for the entire length of the shell, from the anterior adductor to the middle of the posterior margin. An excurrent opening, a slit in the septum connecting the two mantle lobes or a more or less distinct tubuliform siphon, is separated from the free mantle lobe by a short contiguous part and a septum extending ventral-

wards and slightly into the mantle cavity. The anal siphon has smooth edges in the species which have been studied. Below the contiguous part and the septum there is a part, sometimes elongate like a siphon but open ventrally, where the mantle edges may be furnished with tentacles or papillae of varying shape, or may be smooth. This is the incurrent or branchial part of the mantle opening (cfr. text-fig. 10).

In the present paper some anatomical characters which are easily seen or which can easily be studied even in empty valves have been mentioned for most of the species. The posterior part of the mantle margin is always described and drawn from preserved animals and may vary slightly in different specimens according to the degree of contraction. The major features are, however, believed to be correctly shown in the drawings. A thorough anatomical survey of the whole animal will certainly be needed before definite conclusions as to the relations of the various supraspecific groups can be made.

Despite this weakness and certainly some wrong conclusions, it is hoped that this study of a few mytilid species will clarify some questions and be of help for future study.

NOMENCLATURE

The name of a species or a supraspecific group has only one purpose, namely, to be referable to one well circumscribed unit of animals. A scientist should know the supraspecific groups of his specialty so well that on hearing the name of a species unknown to him, he can immediately visualize it by comparison with well known species of the same group. If a supraspecific group is made very wide, however, and therefore vaguely circumscribed, the scientist has to know each species to remember the characters peculiar to it.

By a strict application of the International Rules of Nomenclature, many names, familiar for decades to scientists from some parts of the world, have to be changed. This procedure is inconvenient for present day scientists, but it will not be more difficult for future students than the use today of papers one hundred years old. There have always been different opinions about the scientific names and so numerous changes have been made during the years. Certainly these changes are of no benefit to systematics and taxonomy, and if they could be stopped by fixing names to good descriptions and illustrations, with international cooperation, it would be a great benefit to systematists and to zoologists in all branches.

The specific names used in this paper and the years of publication need some explanation. Hanley's (1842-1856) names are considered to be validated with the publication and distribution of pages 145 to 272 in 1843. Carpenter's (1855-57) names in the Mazatlan Catalogue are dated according to the printing date of each twelve pages and not from 1857. Valuable information on the Linnean names is found in Dodge (1952). The change of Mörch's genus *Chloromya* to *Perna* Retzius has to be made, according to the Rules, though *Perna* has been used by later authors with a quite different meaning, even as a family name. In some cases, the specific names cannot be said to be settled but are still open to doubt and may perhaps be ruled upon by the Commission. Several specific names have been considered synonyms of well known species, but with doubt, and some of them may perhaps be found to represent valid species when more material is accumulated and the type specimens have been carefully compared.

When an author has published a description in a paper written by another author, the last name only is used as reference.

No attempt has been made to give a complete list of synonyms of the genera or species, though most of the names used for the west coast species are supposed to be included and discussed as synonyms.

LIST OF SPECIFIC NAMES USED FOR WEST AMERICAN MYTILIDS

The following list comprises all names found to have been used for mytilids from the west coast of America from the Arctic Ocean in the north to the Strait of Magellan in the south. All names of species are arranged alphabetically, followed by the name of the author or by an author using the name for a west coast species, the year of publication, and in parentheses the generic name used by the describer. On the right side will be found the names supposed to be valid today. Sometimes a name is referred to with doubt and it is then preceded by a question mark. An asterisk before the specific name indicates that the species is found to the north of California only and therefore is not treated in this paper.

abbotti Lowe 1935 *(Lithophaga)*	*?Lithophaga (Leiosolenus) spatiosa* Carpenter 1856
adamsianus Dunker 1856 *(Mytilus)*	*Hormomya adamsiana* Dunker 1856
albus Molina 1782 *(Mytilus)*	*Choromytilus chorus* Molina 1782
algosus Gould 1850 *(Mytilus)*	*Semimytilus algosus* Gould 1850
americanus Orbigny 1846 *(Mytilus)*	*Aulacomya ater* Molina 1782

angustanus Reeve 1857 *non* Lamarck 1819 *(Mytilus)*	*Semimytilus algosus* Gould 1850
appendiculata Tomlin 1928 *(Lithophaga)*	*?Lithophaga (Diberus) canalifera* Hanley 1843
arborescens Lamy 1936 *non* Chemnitz 1795 *(Modiolus (Amygdalum))*	*Amygdalum americanum* n. sp.
arciformis Dall 1909 *(Modiolus)*	*Mytella falcata* Orbigny 1846
aristatus Dillwyn 1817 *(Mytilus)*	*Lithophaga (Myoforceps) aristata* Dillwyn 1817
ater Molina 1782 *(Mytilus)*	*Aulacomya ater* Molina 1782
attenuata Deshayes 1836 *(Modiola)*	*Lithophaga (Labis) attenuata* Deshayes 1836
bicolor Lamarck 1819 *(Mytilus)*	*Mytella guyanensis* Lamarck 1819
bidens Dillwyn 1817 *non* Linné 1758 *(Mytilus)*	*?Aulacomya ater* Molina 1782
bifurcatus Conrad 1837 *(Mytilus)*	*Septifer bifurcatus* Conrad 1837
bifurcatus auct. (Mytilus)	*Hormomya adamsiana* Dunker 1856
bifurcatus Dautzenberg 1896 *(Mytilus)*	*Brachidontes purpuratus* Lamarck 1819
biradiata Hanley 1843 *(Modiola)*	?perhaps not American (cfr. *Modiolus eiseni* Strong and Hertlein 1937)
brasiliensis Chemnitz 1795 *(Mytilus)*	*Mytella guyanensis* Lamarck 1819
californianus Conrad 1837 *(Mytilus)*	*Mytilus californianus* Conrad 1837
californicus Clessin 1889 *(Mytilus)*	*Mytilus californianus* Conrad 1837
californiensis Philippi 1847 *(Modiola)*	*Adula californiensis* Philippi 1847
calyculatus Carpenter 1856 *(Lithophagus)*	*Lithophaga (Stumpiella) calyculata* Carpenter 1856
calyculatus Hertlein and Strong 1946 *(Lithophagus)*	*Lithophaga (Diberus) plumula* Hanley 1843
canaliculus Dall 1876, 1891 *(Mytilus)*	*Mytilus edulis* subsp.
canalifera Hanley 1843 *(Modiola (Lithodomus))*	*Lithophaga (Diberus) canalifera* Hanley 1843
capax Conrad 1837 *(Modiola)*	*Modiolus capax* Conrad 1837
carpenteri Mörch 1861 *(Dactylus)*	*Lithophaga (Myoforceps) aristata* Dillwyn 1817
caudatus Gray 1827 *(Lithophaga)*	*Lithophaga (Myoforceps) aristata* Dillwyn 1817
caudigera Lamarck 1819 *(Modiola)*	*Lithophaga (Myoforceps) aristata* Dillwyn 1817
charruanus Orbigny 1846 *(Mytilus)*	*Mytella falcata* Orbigny 1846
chilensis Hupé 1854 *(Mytilus)*	*Mytilus edulis chilensis* Hupé 1854
chiloensis Reeve 1857 *(Mytilus)*	*Mytilus edulis chilensis* Hupé 1854
chorus Molina 1782 *(Mytilus)*	*Choromytilus chorus* Molina 1782
cinnamomeus Carpenter 1856 *(Lithophagus)*	*Botula fusca* Gmelin 1791
cinnamoneus Strong and Hanna 1930 *(Botula)*	*Botula fusca* Gmelin 1791
coarctata Carpenter 1856 *(Crenella)*	*Gregariella coarctata* Carpenter 1856
columbiana Dall 1897 *(Crenella)*	*Solamen columbianum* Dall 1897

coralliophagus Chemnitz 1785 *(Mytilus)*	*Gregariella coarctata* Carpenter 1856
**corrugatus* Stimpson 1851 *(Mytilus)*	*Musculus corrugatus* Stimpson 1851
crassa Clessin 1889 *(Tichogonia)*	not west American
crenatus Lamarck 1819 *(Mytilus)*	*Aulacomya ater* Molina 1782
cumingi Recluz 1849 *(Septifer)*	*Septifer zeteki* Hertlein and Strong 1946
cumingianus Reeve 1858 *(Mytilus)*	*Septifer zeteki* Hertlein and Strong 1946
cuneiformis Reeve 1857 *(Mytilus)*	*Semimytilus algosus* Gould 1850
dactyliformis Hupé 1854 *(Mytilus)*	*Semimytilus algosus* Gould 1850
decussatus Montagu 1808 *(Mytilus)*	*Crenella decussata* Montagu 1808
decussatus Lamarck 1819 *(Mytilus)*	*Aulacomya ater* Molina 1782
demissus Dillwyn 1817 *(Mytilus)*	*Arcuatula demissa* Dillwyn 1817
denticulata Dall 1871 *(Modiolaria)*	*?Gregariella denticulata* Dall 1871
denticulata auct. non Dall 1871 *(Botulina)*	*Gregariella chenui* Recluz 1842
diegensis Dall 1911 *(Modiolus)*	*Adula diegensis* Dall 1911
diegensis Coe 1945 *(Mytilus)*	*Mytilus edulis* Linné 1758
**discors* Linné 1767 *(Mytilus)*	*Musculus discors* Linné 1767
divaricata Orbigny 1853 *(Nuculocardia)*	*Crenella divaricata* Orbigny 1853
dunkeri auct. non Reeve 1857 *(Mytilus)*	*Mytilus edulis* Linné 1758
ecuadoriana Pilsbry and Olsson 1941 *(Crenella)*	*?Crenella divaricata* Orbigny 1853
edulis Linné 1758 *(Mytilus)*	*Mytilus edulis* Linné 1758
eiseni Strong and Hertlein 1937 *(Modiolus)*	*Modiolus eiseni* Strong and Hertlein 1937
elongatus Chemnitz 1785 *(Mytilus)*	*Perna perna* Linné 1758
exaratus Philippi 1847 *(Mytilus)*	*?Brachidontes purpuratus* Lamarck 1819
exilis Philippi 1847 *(Mytilus)*	*?Brachidontes purpuratus* Lamarck 1819
falcatus Gould 1851 *(Lithodomus)*	*Adula falcata* Gould 1851
falcatus Orbigny 1846 *(Mytilus)*	*Mytella falcata* Orbigny 1846
fischerianus Tapparone-Canefri 1874 *(Mytilus)*	*Mytilus edulis chilensis* Hupé 1854
flabellata auct. non Gould 1850 *(Volsella)*	*Modiolus neglectus* n. sp.
flabellatus Gould 1850 *(Mytilus (Modiola))*	*Modiolus rectus* Conrad 1837
forficatus Ravenel 1861 *(Lithodomus)*	*Lithophaga (Myoforceps) aristata* Dillwyn 1817
fornicata Carpenter 1865 *(Modiola)*	*Modiolus fornicatus* Carpenter 1865
fornicata auct. non Carpenter *(Modiola)*	*Modiolus sacculifer* Berry 1953
fuscus Gmelin 1791 *(Mytilus)*	*Botula fusca* Gmelin 1791
glomeratus Gould 1851 *(Mytilus)*	*Mytilus edulis* Linné 1758
gracilior Carpenter 1856 *(Lithophagus)*	*Lithophaga (Myoforceps) aristata* Dillwyn 1817
gracilior Carpenter 1856 *(Lithophagus)*	*Lithophaga (Diberus) plumula* Hanley 1843

granulatus Hanley 1843 *(Mytilus)*	*Hormomya granulata* Hanley 1843
grayanus auct. non Dunker 1853 *(Mytilus)*	*Mytilus edulis* Linné 1758
**grisea* Dall 1907 *(Crenella)*	*Crenella grisea* Dall 1907
guyanensis Lamarck 1819 *(Modiola)*	*Mytella guyanensis* Lamarck 1819
hamatus Say 1822 *(Mytilus)*	*Ischadium recurvus* Rafinesque 1820
houstonius Bartsch and Rehder 1939 *(Brachidontes)*	*Brachidontes houstonius* Bartsch and Rehder 1939
hupeanus Rochebrune et Mabille 1889 *(Mytilus)*	*Mytilus edulis chilensis* Hupé 1854
**impressa* Dall 1907 *(Modiolaria)*	*Musculus impressus* Dall 1907
inca Orbigny 1846 *(Lithodomus)*	*Lithophaga (Labis) attenuata* Deshayes 1836
inflata Carpenter 1864 *(?Crenella)*	*?Crenella divaricata* Orbigny 1853
infumatus Rochebrune et Mabille 1889 *(Mytilus)*	*Mytilus edulis chilensis* Hupé 1854
kelseyi Hertlein and Strong 1946 *(Lithophaga)*	*Lithophaga (Diberus) subula* Reeve 1857
labiata Carpenter MS *(Modiola)*	*Modiolus sacculifer* Berry 1953
**laevigata* Gray 1824 *(Modiola)*	*Musculus laevigatus* Gray 1824
**laevis* Beck 1851 *(Modiolaria)*	*Musculus laevis* Beck 1851
latissimus Carpenter 1857 *(Mytilus edulis var.)*	*Mytilus edulis* Linné 1758
latus Lamarck 1819 *(Mytilus)*	*Choromytilus chorus* Molina 1782
**leana* Dall 1897 *(Crenella)*	*Crenella leana* Dall 1897
magellanica Retzius 1788 *(Perna)*	*Perna perna* Linné 1758
magellanicus Chemnitz 1785 *(Mytilus)*	*Aulacomya ater* Molina 1782
magellanicus Röding 1798 *(Mytilus)*	*Perna perna* Linné 1758
**marmorata auct.-?* Forbes 1838 *(Mytilus (Modiola))*	*?Lanistina* sp.
megas Dall 1902 *(Crenella)*	*?Solamen columbianum* Dall 1897
modiolus Linné 1758 *(Mytilus)*	*Modiolus modiolus* Linné 1758
multiformis Carpenter 1855 *(Mytilus)*	*Brachidontes multiformis* Carpenter 1855
mutabilis Carpenter 1856 *(Modiola)*	*Mytella guyanensis* Lamarck 1819
mutabilis auct. non Carpenter 1856 *(Modiola)*	*Mytella falcata* Orbigny 1846
**nigra* Gray 1824 *(Modiola)*	*Musculus niger* Gray 1824
nitens auct. non Carpenter 1855 *(Mytilus)*	*Mytella falcata* Orbigny 1846
nonuranus Pilsbry and Olsson 1935 *(Modiolus)*	*Semimytilus algosus* Gould 1850
**obesus* Dall 1916 *(Musculus)*	*Musculus obesus* Dall 1916
obesus Reeve 1858 *(Mytilus)*	*Mytilus edulis chilensis* Hupé 1854
oblongus Clessin 1889 *(Mytilus)*	*Aulacomya ater* Molina 1782
obsoletus Dall 1916 *(Septifer)*	*Septifer bifurcatus* Conrad 1837
olivaceus Dall 1916 *(Musculus)*	*Musculus olivaceus* Dall 1916

opifex auct. non Say 1825 *(Modiola)*
orbignyanus Hupé 1854 *(Mytilus)*
**pacificum* Dall 1916 *(Dacrydium)*
pallidulus Dall 1916 *(Modiolus)*
palliopunctatus Carpenter 1855 *(Mytilus)*
patagonicus Clessin 1889 *(Mytilus)*
patagonicus Reeve 1857 *(Mytilus)*
patagonicus auct. non Orbigny 1846 *(Mytilus)*
pellucidus Pennant 1777 *(Mytilus)*
perna Linné 1758 *(Mya)*
peruvianus Orbigny 1846 *(Lithodomus)*

**phenax* Dall 1915 *(Musculus)*
pilosus Reeve 1858, Stempell 1902 *(Mytilus)*
planulatus Lamarck 1819 *(Mytilus)*
playasensis Pilsbry and Olsson 1935 *(Modiolus (Brachidontes))*
plicatula Lamarck 1819 *(Modiola)*
plumula Hanley 1843 *(Modiola (Lithodomus))*
plumula Hertlein and Strong 1946 *(Lithophaga (Diberus))*
politus Dall 1916 *(Modiolus)*
protractus Dall 1916 *(Musculus)*
puntarenensis Pilsbry and Lowe 1932 *(Mytilus (Hormomya))*
purpurata Lamarck 1819 *(Modiola)*
pyriformis Gould 1850 *(Mytilus)*
recta Conrad 1837 *(Modiola)*
recta auct. non Conrad 1837 *(Modiolus)*
recurvus Rafinesque 1820 *(Mytilus)*
rotundata Dall 1916 *(Crenella)*
rugiferus Dunker in Carpenter 1856 *(Lithophagus)*
sacculifer Berry 1953 *(Volsella)*
salvadorica Hertlein and Strong 1946 *(Volsella)*
semicostata Conrad 1837 *(Modiola)*
semifusca Sowerby 1830 *(Modiola)*
semilaevis Menke 1849 *(Modiola)*

**seminuda* Dall 1897 *(Modiolaria)*
senhausi Reeve 1857 *(Modiola)*
similis Clessin 1889 *(Mytilus)*
sinuosa King 1831 *(Modiola)*

Gregariella chenui Recluz 1842
Aulacomya ater Molina 1782
Dacrydium pacificum Dall 1916
Amygdalum pallidulum Dall 1916
Choromytilus palliopunctatus Carpenter 1855
Semimytilus algosus Gould 1850
Semimytilus algosus Gould 1850
Mytilus edulis chilensis Hupé 1854

Mytilus edulis Linné 1758
Perna perna Linné 1758
Lithophaga (Labis) peruviana Orbigny 1846
Musculus phenax Dall 1915
?Hormomya granulata Hanley 1843

Mytilus edulis Linné 1758
Brachidontes playasensis Pilsbry and Olsson 1935
Arcuatula demissa Dillwyn 1817
Lithophaga (Diberus) plumula Hanley 1843
Lithophaga (Diberus) plumula Hanley 1843
Amygdalum pallidulum Dall 1916
Musculus protractus Dall 1916
Brachidontes puntarenensis Pilsbry and Lowe 1932
Brachidontes purpuratus Lamarck 1819
Aulacomya ater Molina 1782
Modiolus rectus Conrad 1837
Modiolus neglectus n. sp.
Ischadium recurvus Rafinesque 1820
?Solamen columbianum Dall 1897
?Lithophaga (Leiosolenus) spatiosa Carpenter 1856
Modiolus sacculifer Berry 1953
Lioberus salvadoricus Hertlein and Strong 1946
Arcuatula demissa Dillwyn 1817
Mytella guyanensis Lamarck 1819
?Brachidontes multiformis Carpenter 1855
Musculus seminudus Dall 1897
Musculus senhousei Benson 1842
Semimytilus algosus Gould 1850
Mytella guyanensis Lamarck 1819

soleniformis Orbigny 1846 *(Mytilus)*	*Adula soleniformis* Orbigny 1846
spatiosus Carpenter 1856 *(Leiosolenus)*	*Lithophaga (Leiosolenus) spatiosa* Carpenter 1856
spatula Menke 1849 *(Mytilus)*	*?Modiolus capax* Conrad 1837
speciosa Reeve 1857 *(Modiola)*	*Mytella speciosa* Reeve 1857
splendens Dunker 1856 *(Mytilus)*	*?Modiolus capax* Conrad 1837
splendida Dunker 1856 *(Volsella)*	*Semimytilus algosus* Gould 1850
stearnsi Pilsbry and Raymond 1898 *(Mytilus)*	*Hormomya adamsiana* Dunker 1856
strigatus Hanley 1843 *(Mytilus)*	*?Mytella falcata* Orbigny 1846
stylina Carpenter 1864 *(Adula)*	*Adula californiensis* Philippi 1847
subfuscata Clessin 1889 *(Modiola)*	*?Modiolus capax* Conrad 1837 or *Mytella guyanensis* Lamarck 1819
**substriata* Gray 1824 *(Modiola)*	*Musculus substriatus* Gray 1824
subula Reeve 1857 *(Lithodomus)*	*Lithophaga (Diberus) subula* Reeve 1857
**taylori* Dall 1897 *(Modiolaria)*	*Musculus taylori* Dall 1897
trifurcatus Dunker 1853 *(Mytilus)*	*Septifer bifurcatus* Conrad 1837
trossulus Gould 1850 *(Mytilus)*	*Mytilus edulis* Linné 1758
tumbezensis Pilsbry and Olsson 1935 *(Modiolus)*	*Mytella speciosa* Reeve 1857
tumidior Carpenter 1856 *(Lithophagus)*	*Lithophaga (Myoforceps) aristata* Dillwyn 1817
tumidior Carpenter 1856 *(Lithophagus)*	*Lithophaga (Diberus) plumula* Hanley 1843
ungulatus Lamarck 1819 *(Mytilus)*	*Choromytilus chorus* Molina 1782
**vernicosa* Middendorf 1849 *(Modiolaria)*	*Musculus vernicosus* Middendorf 1849
violaceus Clessin 1889 *(Mytilus)*	*Mytilus edulis chilensis* Hupé 1854
zeteki Hertlein and Strong 1946 *(Septifer)*	*Septifer zeteki* Hertlein and Strong 1946

THE *"MYTILUS"*-GROUP

Mytiliform species were recorded very early in the history of the family. Newell (1942) has placed the Paleozoic species in the genus *Promytilus* with species of the same form as the recent ones. Nothing is known or published on the hinge characters or the muscle scars. The Jurassic genus *Falcimytilus* Cox (1937) is described as being without anterior teeth, otherwise very like the recent forms. Several other supra-specific groups are established for fossil species, but so far as I know without detailed characters of the hinge or the muscle scars. It is therefore at present impossible to establish pedigrees or to trace the relationship of the species.

The mytilid form seems to be successful for species living in colonies fastened with a byssus to rocks or seaweeds. In the pointed anterior end is only a small space for an anterior adductor which, therefore, has a tendency to become reduced. To obtain a rapid and complete closing of the valves, the posterior adductor is larger and the posterior retractors of the byssus are strong, so the shell can be pressed against the support. Strong retractor muscles need space for the adherence to the shell and are therefore found in a long flattened band before the adductor or separated into two strings. Usually the narrow anterior margin is furnished with tooth-like folds formed by the radiating sculpture of the lunule. The sculpture seems to be the remains of a radiating sculpture in the ancestors, which perhaps were like modern species of the *Brachidontes* or the *Hormomya*-group. In small species, *e. g.,* of *Mytilus s. s.,* the teeth are not interlocking but are separated by the periostracum bent inwards in both valves. In other groups where the lunule is more or less completely bent inwards, the teeth, or more correctly the folds, interlock.

The posterior part of the mantle margin, the branchial opening, is furnished with tentacles or papillae of various forms usable as filtering and sensory organs. Nearly all mytiliform species seem to have such papillae. The dorsal or anal opening is sometimes in the form of a short siphon, sometimes an opening in the septum connecting the two mantle margins.

As stated before, all mytiliform species have been included in the genus *Mytilus s. l.,* though representing different subgenera or sections. The differences which can be seen inside the valves or in the soft parts, are in reality greater than those used for the separation of genera or even subfamilies in other pelecypod families. In this paper two new generic names are introduced for species differing considerably from *Mytilus s. s.,* one of which is not represented in the recent fauna of west America. The grouping together of the five genera of mainly smooth mytiliform species seems at present to be unwise. Many students and especially the palaeontologists certainly will prefer to use *Mytilus* for all these species on the basis of the outer form, but in that case *Aulacomya* has also to be included. That such a procedure will clarify and simplify the relationship of these species seems questionable. The heading of this section does not indicate a relationship of mytiliform species *a priori* or that these genera are more closely related to each other than to other genera of the family, but only that they have been supposed to constitute a uniform group.

SYSTEMATICAL PART

KEY TO GENERA OF MYTILIDS BASED ON WEST AMERICAN SPECIES

1. Resilial ridge pitted 2
   Resilial ridge compact 4
2. No anterior adductor, posterior retractor scars widely separated . . . . . *Perna*
   Anterior adductor present 3
3. Anterior retractor scar elongate, posterior retractors continuous, several small teeth present . . . . . *Mytilus*
   Anterior retractor scar round, posterior retractors separated, anterior margin with or without teeth; more or less green colored . . . . . *Mytella*
4. Lunule with radial sculpture and anterior margin with teeth or crenulations 5
   Lunule smooth, anterior margin without teeth or crenulations, shell smooth or with irregular sculpture 18
5. Shell with concentric or irregular sculpture, or smooth 6
   Shell with radial sculpture though sometimes obsolete 9
6. Anterior retractor before umbo, scars of siphonal muscles visible; shell elongate lithophagiform or modioliform, smooth or with irregular sculpture . . . . . *Adula*
   Anterior retractor elongate, behind umbo, shell mytiliform . . . 7
7. 1 to 3 distinct teeth or folds 8
   No real teeth, lunule bordered by a faint line . . . *Semimytilus*
8. Anterior adductor strong, shell margin minutely crenulated . . . . . *Crenomytilus*
   No anterior adductor, shell margin smooth . . . . *Choromytilus*
9. Strong tooth-like crenulations behind the ligament 10
   Dorsal margin behind ligament smooth or crenulated like the rest of the margins 12
10. Anterior adductor placed on a septum in each valve . . . *Septifer*
    No anterior septum 11
11. Umbones subterminal, anterior hinge margin bent in an angle, radial sculpture on ventral part simple or regularly bifurcating, posterior retractors fastened to dorsal part of posterior adductor . . . . . *Brachidontes*

Umbones usually terminal, radial sculpture on ventral part unilaterally bifurcate, posterior retractors fastened below the dorsal part of the posterior adductor . . . . *Hormomya*

12. Mytiliform species with 1 to 3 tooth-like ridges or small teeth, anterior adductor obsolete or missing 13

Anterior margin crenulated, anterior adductor distinct . . . 14

13. Margins smooth or with folds in young specimens, anterior retractor elongate, hinge with 1 to 3 tooth-like folds . *Aulacomya*

Margins crenulate, anterior retractor round, posterior retractors broadly united with the posterior adductor, hinge with several small teeth . . . . . *Ischadium*

14. Radial sculpture of equal strength over the whole surface, smaller greyish or yellowish-white species with thin periostracum 15

Radial sculpture weaker or absent on the median part of the shell, periostracum strong 16

15. Radial ribs relatively strong, a crenulated tooth-like process below umbo, ligament deep-set . . . . . *Crenella*

Radial striations numerous and fine, no tooth-like process below umbo in adult shells, ligament more marginal . . *Solamen*

16. Radial sculpture distinct though weaker in the median part of the shell, anterior retractor in the umbonal cavity and a small but distinct scar between the anterior adductor and retractor . . . . . *Arcuatula*

No radial sculpture on the median part of the shell, anterior retractor before umbo 17

17. Umbonal keel low, periostracum without hairlike protuberances . . . . . *Musculus*

Umbonal keel pronounced, periostracum with long hairlike protuberances on the keel . . . . . *Gregariella*

18. Ligament short below umbo, small white or hyaline species with thin shiny periostracum 19

Ligament elongate, larger species with strong periostracum . . 20

19. Hinge without grooved teeth on the sides of the chondrophore, anterior margin thickened . . . . . *Dacrydium*

Hinge with two grooved teeth with a small median chondrophore, anterior margin not thickened . . . . . *Quendreda*

20. Shell elongate, lithophagiform with parallel dorsal and ventral margins, periostracum strong with irregular sculpture or chalky or filthy incrustations, anterior retractor before umbo 21

Shell relatively higher, periostracum smooth or with hairlike protuberances, anterior retractor usually behind umbo . . . 22

21. Shell coated with chalky incrustations especially on the posterodorsal part; margins smooth . . . . . *Lithophaga*
Shell with irregular sculpture or a filthy incrustation on the posterodorsal part, dorsal margin sometimes crenulated . *Adula*

22. Dorsal margin crenulated above and behind the ligament, anterior adductor placed on the margin below umbo . . *Botula*
Dorsal margin smooth, anterior adductor not placed on the margin 23

23. Shell mytiliform, lunule bordered by a faint line, anterior retractor elongate, behind umbo . . . . . *Semimytilus*
Shell with broader rounded anterior margin, anterior retractor rounded 24

24. Anterior retractor in or behind umbo 25
Anterior retractor before umbo 26

25. Greyish or yellowish-white, usually spotted, species with shiny periostracum; first posterior retractor small, widely separated from the hinder one . . . . . *Amygdalum*
Brownish species with thick periostracum often with hairs, posterior retractors continuous . . . . . *Modiolus*

26. No furrow separating the posterodorsal area from the rest of the shell . . . . . *Lioberus*
A furrow from umbo to the posterior part of the ventral margin is present . . . . . *Musculus*

Genus **MYTILUS** Linné 1758

Mytilus Linné, Systema Naturae, ed. 10, 1758, p. 704.

Syn.: Eumytilus Ihering 1900.

Type of genus: Mytilus edulis Linné 1758 (subsequent designation by Gray 1847).

Remarks: This Linnean genus, which originally contained several very unlike shells now referred to different families, is here restricted to those species which have the features characteristic of *Mytilus edulis* Linné. These are mainly the anterior position of the umbones, the dysodont teeth on the short anterior margin formed by the radial ridges of the lunule, a small anterior adductor, elongate scars of the anterior retractor well behind the umbones, continuous scars of the large posterior adductor and retractors, and the distinctly pitted resilial ridge which fastens the ligament to the nymphae. The posterior part of the mantle margins are furnished with tentacles or papillae.

The species of *Mytilus s. s.* are extremely variable in regard to outline, color, and the thickness of the valves, and consequently many names have been applied to the different forms.

Mytilus s. s. seems to be of a relatively recent origin, as no records of species which certainly belong to the restricted genus are older than Pliocene. The recent distribution of *M. edulis* suggests, however, that this species must be rather old. Three or four species may be recognized, *viz.*, *Mytilus edulis* Linné 1758, with geographical subspecies; *Mytilus californianus* Conrad 1837; *Mytilus crassitesta* Lischke 1868 (Japan), and perhaps *Mytilus giganteus* Nordmann 1862.

The two west American species are generally easily separated:

Shell smooth, anterior adductor placed along the anteroventral margin . . . . . *edulis* Linné

Shell with radial ribs, anterior adductor placed more anteriorly . . . . . *californianus* Conrad

Mytilus edulis Linné 1758

Pl. 1, figs. 1-2; text-figs. 1, 2, 10, 11

Mytilus edulis Linné, Systema Naturae, ed. 10, 1758, p. 705.

Syn.: Mytilus pellucidus Pennant 1777.
Mytilus angustanus Lamarck 1819.
Mytilus galloprovincialis Lamarck 1819.
Mytilus planulatus Lamarck 1819.
Mytilus platensis Orbigny 1846.
Mytilus trossulus Gould 1850.
Mytilus glomeratus Gould 1851.
Mytilus chilensis Hupé 1854.
Mytilus edulis var. *latissimus* Carpenter 1857.
Mytilus grunerianus Reeve 1857.
Mytilus chiloensis Reeve 1857.
Mytilus obesus Reeve 1858.
Mytilus fischerianus Tapparone-Canefri 1874.
Mytilus canaliculus Dall 1876, 1891 (*non* Martyn 1784).
Mytilus infumatus Rochebrune et Mabille 1889.
Mytilus hupeanus Rochebrune et Mabille 1889.
Mytilus septentrionalis Clessin 1889.
Mytilus violaceus Clessin 1889 (*non* Lamarck 1819).
Mytilus (Eumytilus) patagonicus Jukes-Browne 1905 (*non* Hanley 1843, Orbigny 1846).

Mytilus edulis patagonicus Ihering 1907
(*non* Hanley 1843, Orbigny 1846).
Mytilus desolationis Lamy 1936.
Mytilus kerguelensis Fletcher 1938 (*non* Smith 1885).
Mytilus dunkeri cfr. Bartsch 1943 (*non* Reeve 1857).
Mytilus edulis diegensis Coe 1945.
Mytilus patagonicus Carcelles 1950, 1951
(*non* Hanley 1843, Orbigny 1846).

Holotype: Linnean Society ?

Type locality: North Atlantic.

Remarks: This list of synonyms is not complete, but is supposed to contain all names used for this species from the west coast of America, as well as those considered to constitute geographical subspecies. Usually *Mytilus edulis* has been used for specimens from the northern parts of the Atlantic and Pacific Oceans, while specimens from the west coast of South America have been considered to constitute a subspecific unit *M. edulis chilensis* Hupé, and those from the east coast of South America another unit *M. edulis platensis* Orbigny. Specimens from the Kerguelen Islands were named *M. desolationis* by Lamy (*M. kerguelensis* Fletcher), while those from Australia and New Zealand are known as *M. edulis planulatus* Lamarck. The higher, flatter forms with very small anterior adductor are named *M. galloprovincialis* Lamarck in the Mediterranean and *M. diegensis* Coe in California. Though there might be distinctive forms living in the neighborhood of each other, these forms seem to occur in all areas where *M. edulis* is living. They may be ecological forms or genetically determined, but at present it seems impossible to circumscribe a group of specimens from one locality so well that they can be recognized in a large collection from many localities. On the other hand, one would be inclined to suppose that the geographically widely separated populations are evolving or have acquired some characters, though minute, in shell, animal, or in their biology, which might separate them from other populations. It seems, therefore, to be advisable to use special names for some of the geographically separated populations as subspecies, even if no morphological characters for their separation can be indicated.

Mytilus edulis is often considered to be a cosmopolite, but that is wrong. It has a definite distributional pattern comparable to that found in *Choromytilus* and *Aulacomya,* showing that these genera have had at least partly the same history in, geologically speaking, relatively recent times.

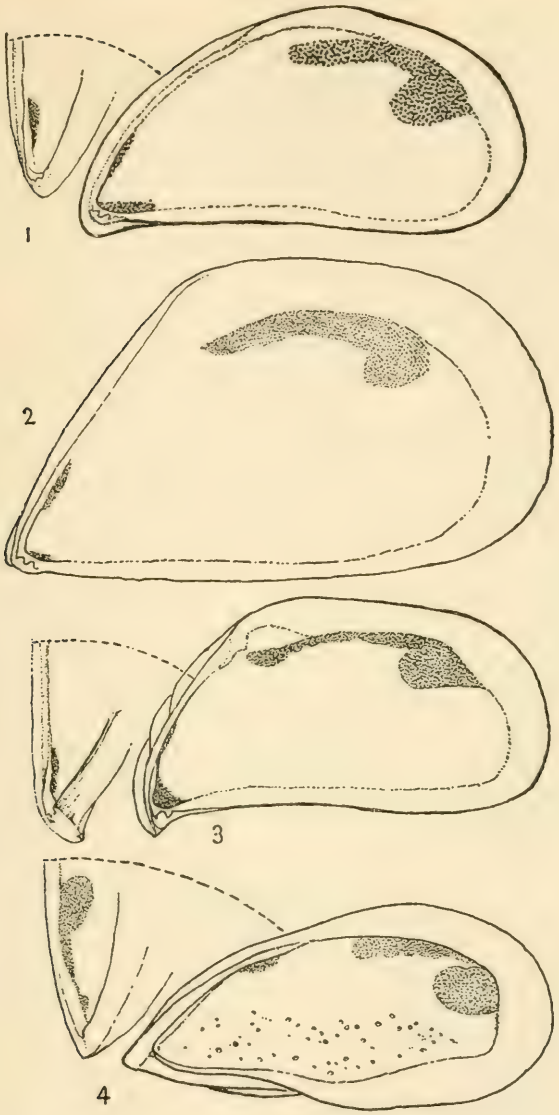


Fig. 1. *Mytilus edulis* Linné. Yaquina Bay, Oregon. Common thick-shelled form.

Fig. 2. *Mytilus edulis* Linné. Mission Bay, San Diego. High, thin-shelled form with small anterior adductor (*diegensis* Coe).

Fig. 3. *Mytilus californianus* Conrad. San Pedro. Note the placement of the anterior adductor.

Fig. 4. *Choromytilus palliopunctatus* (Carpenter). Salina Cruz, Oaxaca, Mexico. Anterior retractor placed behind the middle of the ligament; no anterior adductor.

The Californian form named *M. diegensis* by Coe, by some thought to be *M. grayanus* Dunker=*M. dunkeri* Reeve introduced from Japan, is a high flat form with a very small anterior adductor and sometimes with a greenish shine in the periostracum. The posterior part of the mantle margin has small papillae and is unpigmented in many specimens, and thus seems to constitute a subspecies. However a large amount of material was found intermediate between the lower more inflated form with mantle margins more or less pigmented, and forms with different sized tentacles. Sometimes the color of the shell is brown, not blue as usual. Such specimens seem to have been taken in deeper water or in places where the light is weak. Where many specimens live crowded together under unsuitable conditions, the specimens are small, short, and often of an unusual form (*M. glomeratus* Gould).

Occurrence: M. edulis is usually found in the intertidal zone attached to stones, rocks, or pilings. Sometimes specimens live in deeper water, at least down to 10 to 20 fms. Fresh shells were found on the beach at San Felipe, Gulf of California, but apparently they were bait brought there by fishermen.

Distribution: North America's west coast from the Arctic Ocean to Cabo San Lucas, Baja California; the west coast of South America (*chilensis* Hupé), Valparaiso to the Strait of Magellan; the east coast of South America (*platensis* Orbigny), north to Brazil; the east coast of North America from Greenland to North Carolina (Cuba?); Europe from the White Sea to the Mediterranean, and northern Africa; Kerguelen Island (*desolationis* Lamy); Australia and New Zealand (*planulatus* Lamarck).

Mytilus californianus Conrad 1837

Plate 1, figs. 3-4; text-figs. 3, 12

Mytilus californianus Conrad, Jour. Acad. Nat. Sci. Phila., vol. 7, 1837, p. 242, Pl. 18, fig. 15.

Syn.: Mytilus californicus Clessin 1889.

Holotype: ?

Type loc.: San Diego, California.

Remarks: This species is usually easy to recognize by the radiating ribs. In shape, however, it varies from the broad bay form to the elongate irregular and worn form living in the surf. Small specimens may sometimes be difficult to separate from small specimens of *Mytilus edulis,* but the placement of the anterior adductor is different. In *M. californianus,*

the scar of the anterior adductor is placed between the dorsal and ventral margin in the anterior angle. The mantle margins are furnished with large tentacles arranged in groups, and are generally heavily pigmented. Large specimens are recorded to a length of nine inches.

Occurrence: *Mytilus californianus* is very common, especially along the more exposed coast in the intertidal zone. Sometimes found living in deeper water to 25 fms (Berry, 1954).

Distribution: Aleutian Islands south to Isla Socorro, Mexico.

Genus CRENOMYTILUS new genus

Plate 2, figs. 9-10; text-fig. 7

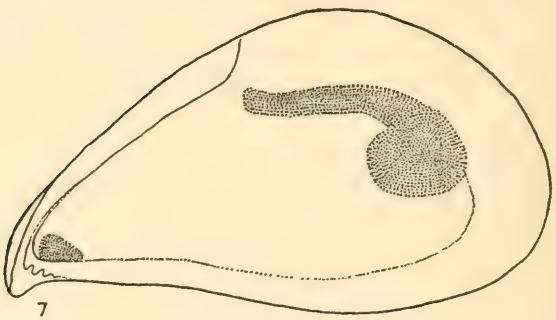
Syn.: Mytiloconcha auct. non Conrad 1862.

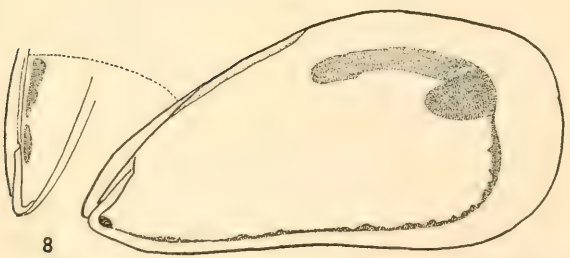
Diagnosis: Shell mytiliform with terminal umbones, lunule grooved and incurved, forming two to three large teeth usually obsolete in old specimens, as there is a pronounced tendency to a growth in thickness by depositing new shell material on the inside of the valves. Margins, especially the anteroventral one, finely crenulated, the crenulations apparently formed as a result of the building up of the crystals in the valves; shell obliquely striated, especially distinct on the ventral surface. Resilial ridge compact; anterior adductor strong, showing a distinct thickened scar; anterior retractor scar elongate behind umbo; posterior adductor and retractor scars continuous. The soft parts have not been studied.

Type of genus: Mytilus grayanus Dunker 1853.

This group of mytiliform species is distinguished from similar forms by the compact resilial ridge, the strong anterior adductor, and the fine crenulation of the margins. No recent species is recorded from America, but during the Tertiary this group seems to have been widely distributed along the west coast of North America. These species have usually been listed as *Mytiloconcha* Conrad, which, however, seems to be based on an old, thick specimen of *Myoconcha incurva* Conrad without anterior adductor and apparently belonging to *Perna* Retzius.

The west coast Tertiary species are: *Crenomytilus mathewsoni* (Gabb) 1866 (Oligocene); *C. trampasensis* (Clark) 1915 (Miocene); *C. coalingensis* (Arnold) 1910 (Upper Miocene); *C. kewi* (Nomland) 1916 (Pliocene); and perhaps also other species listed as *Mytilus*. The only recent species seems to be *C. grayanus* (Dunker) 1853 = *M. dunkeri* Reeve 1857, from the Kuril Islands south to the Philippine Islands. The name *Mytilus dunkeri* has erroneously been used for the form of *Mytilus* named *diegensis* by Coe (1945).





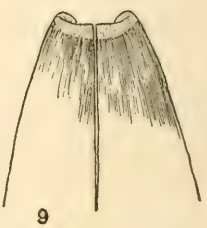


Fig. 5. *Choromytilus chorus* (Molina). Chile. No anterior adductor, anterior retractor distant from umbo.

Fig. 6. *Perna perna* (Linné). Magellan Straits (Videnskabsselskabets Museum, Trondheim, Norway). Posterior retractors widely separated.

Fig. 7. *Crenomytilus grayanus* (Dunker). Japan (San Diego Museum). Strong anterior adductor.

Fig. 8. *Semimytilus algosus* (Gould). North Chincha Island, Peru. Anterior retractor shows two scars.

Fig. 9. *Semimytilus algosus* (Gould). North Chincha Island, Peru. Anterior part seen from the ventral side, showing the fold on the lunule.

Genus SEMIMYTILUS new genus

Diagnosis: Shell mytiliform with nearly terminal umbones; lunule small and circumscribed by a fine line; anterior margin without teeth, slightly bent outward and usually constricted to form a rounded anterior margin. Anterior adductor present, posterior adductors and retractors continuous, anterior retractor fastened below the ligament behind the umbo, elongate, narrow, separated in the middle; resilial ridge compact. Pallial margin with groups of papillae.

Type of genus: Mytilus algosus Gould 1850.

This genus differs from *Mytilus s. s.* and *Perna* by the compact resilial ridge, from *Choromytilus* by the presence of an anterior adductor, and from all by the lack of teeth on the lunular margin. The fine incised line which circumscribes the lunule and constricts the anterior margin is of the same type as the two or more lines found on the lunule of species of the related genera and there forming teeth on the anterior margin.

So far as is known, *Mytilus algosus* is the only species which is referable to this group. There are some small Pacific species which perhaps are closely related, but a thorough study of preserved specimens is necessary before any other species can be referred to *Semimytilus.*

If no other species should be referable to *Semimytilus,* this group is confined to the west coast of South America.

Semimytilus algosus (Gould) 1850

Plate 4, fig. 17; text-figs. 8, 9, 14, 15, 16

Mytilus algosus Gould, Proc. Boston Soc. Nat. Hist., vol. 3, 1850, p. 344; United States Exploring Expedition, vol. 12, 1852, p. 450, Atlas, 1856, Pl. 41, figs. 566, 566a.

Syn.: *Mytilus dactyliformis* Hupé 1854.
Mytilus splendens Dunker 1856, *non* Reeve 1857.
Mytilus cuneiformis Reeve 1857, *non* Hanley 1843.
Mytilus angustanus Reeve 1857 (Clessin 1889), *non* Lamarck 1819.
Mytilus patagonicus Clessin 1889, *non* Orbigny 1846.
Mytilus similis Clessin 1889.
Modiolus nonuranus Pilsbry and Olsson 1935.

Holotype: U. S. National Museum?

Type loc.: Fiji Islands (!) wrong locality. Valparaiso, Chile, is here designated as the type locality.

Remarks: Unfortunately Gould gave "Feejee Islands" as the locality where this species was obtained by the Exploring Expedition. Several

localities from this expedition are wrong, as the material had been handled by incompetent nonscientific personnel. The excellent figure in the plates from the Expedition leaves no doubt that this species is the rather common South American species later recorded under several different names. The Exploring Expedition visited Valparaiso, Chile, and Callao, Peru. It therefore seems safe to make Valparaiso the type locality.

There has been much confusion about this common and variable species and different authors have described the varieties several times. Some names have been used in another sense than the describer intended and all these names have been listed in various ways by later authors. As far as it can be determined after a study of many collections, there is only one species of this group along the coasts of South America. Sometimes the specimens are elongated, sometimes short and more inflated, and small samples of each form may easily be considered to represent two different species.

The main characters separating *S. algosus* from other related species are those as given under the genus *Semimytilus*. The figures of the shell with muscle scars show that the anterior margin grows backward and often ends in a toothlike point. The fold bordering the more dull lunule is sometimes difficult to see, but with some experience this species can be determined with the valves closed. Young specimens may be very like young *Choromytilus palliopunctatus,* but the form and placement of the anterior retractor easily separate the two species.

The posterior part of the mantle is furnished with branched tentacles and papillae of a very distinct form. The dorsal siphon is long and protruding, with smooth margins; the septum is short. The posterior parts

Fig. 10. *Mytilus edulis* Linné. Yaquina Bay, Oregon. Common form, posterior part of mantle. A.P.- posterior adductor; D.O.- Dorsal or anal opening; S.- septum connecting both mantle flaps in the branchial opening.

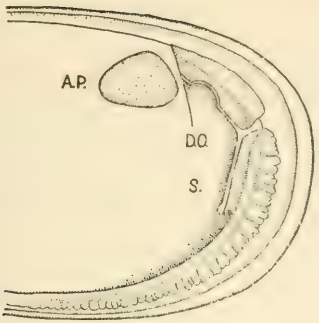
Fig. 11. *Mytilus edulis* Linné. Newport Harbor. High form (*diegensis* Coe). Posterior part of mantle with small papillae.

Fig. 12. *Mytilus californianus* Conrad. San Pedro. Posterior part of mantle. a. Enlarged papillae.

Fig. 13. *Choromytilus palliopunctatus* (Carpenter). Salina Cruz, Oaxaca, Mexico. Posterior part of mantle. a. Enlarged papillae.

Fig. 14. *Semimytilus algosus* (Gould). North Chincha Island, Peru. Posterior part of mantle. a. Enlarged papillae from the inside. b. Enlarged papillae from the outside.

Fig. 15. *Semimytilus algosus* (Gould). North Chincha Island, Peru. A.R.B. - anterior retractor byssi, here divided into two branches; B. - byssus; F.R.-foot retractor; P. R. B. - posterior retractor byssi.



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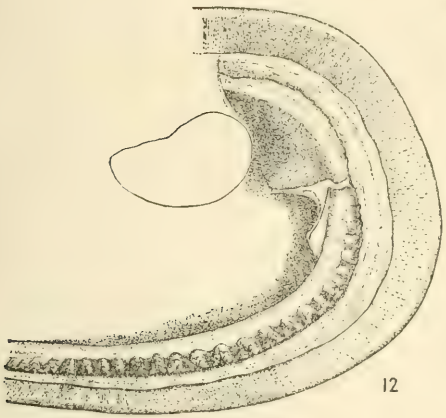
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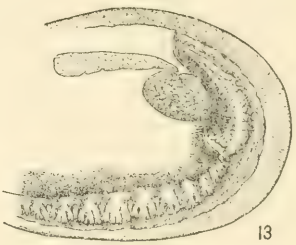
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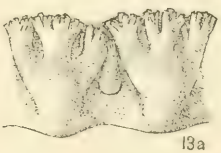
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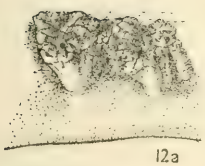
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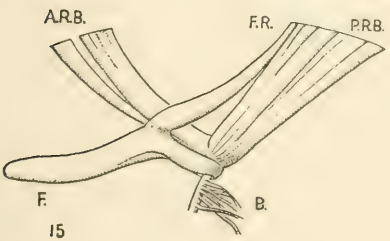

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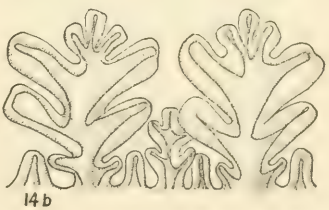
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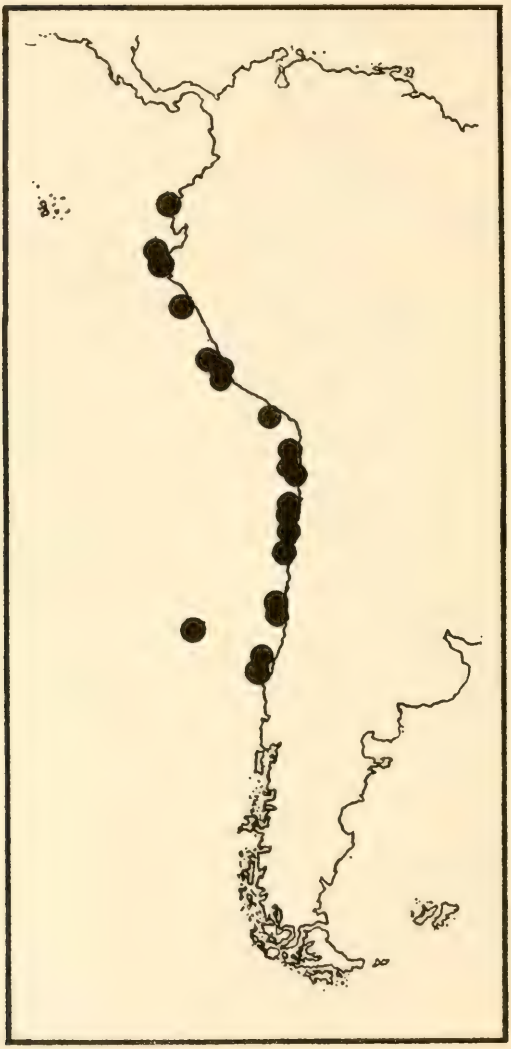


Fig. 16. *Semimytilus algosus* (Gould). Distribution according to samples from various sources.

usually have a dark brown pigment. The foot retractor is weak compared to the strong byssal retractors, of which the anterior has two separate branches. The byssus consists of fine yellowish threads grown out from a central stem.

Occurrence: S. algosus is found from the shore down to a few fathoms. Smaller specimens are often fastened to the holdfasts of *Macrocystis* and other algae, but usually they seem to be found along rocky shores. Some samples consist of many specimens fastened together by their byssal threads.

Distribution: According to samples studied in various collections, the northernmost locality where *S. algosus* is found is Manta, Ecuador, and the southernmost is Tumbes, Chile. It is also recorded from the Juan Fernandez Islands (Hassler Expedition).

Genus **PERNA** Retzius 1788

Perna Retzius, Dissertatio historico-naturalis nova Testaceorum genera, 1788, p. 20.

Syn.: Chloromya Mörch 1853.

Mytiloconcha Conrad 1862.

Type of genus: Perna magellanica Retzius 1788=*Mya perna* Linné 1758. (I have been unable to find an earlier designation; therefore *Perna magellanica* Retzius 1788 is here designated the type of genus *Perna* Retzius 1788.)

Remarks: Mörch (1853) himself states that his *Chloromya* is like *Perna* Retzius *non* Adanson. It is therefore remarkable that *Chloromya* has been in use for so many years. Unfortunately *Perna* has been used by Bruguière 1792 (=*Pedalion*) and by H. and A. Adams 1858 as of Adanson (=*Modiolus*). *Mytiloconcha* Conrad was erected for his *Myoconcha incurva* which has a very thick anterior part due to the internal increase of the shell. The type species has no anterior adductor, but a pitted resilial ridge, and shows no special difference from old specimens of *Perna.*

This genus is characterized by the pitted resilial ridge, the anterior position of the foot retractor, and the missing anterior adductor. The shell is more margaritaceous than the other *Mytilus*-like genera and sometimes shows a beautiful green color.

Perna perna (Linné) 1758

Text-fig. 6

Mya perna Linné, Systema Naturae, ed. 10, 1758, p. 671.
Syn.: Mytilus elongatus Chemnitz 1785.
Perna magellanica Retzius 1788.
Mytilus magellanicus Röding 1798.
Holotype: ?
Type loc.: Strait of Magellan.
Remarks: Linné described this species as a *Mya.* His short description is followed by a reference to "Argenv. conch. t. 25, f. N" and the habitat is "in freto Magellanico." Argenville, Pl. 25, fig. N, represents an elongate mytilid and on p. 331 *sub.* fig. N, he says: "La Moule qu'on voit à la lettre N, est d'une très beau violet mêlé de Pourpre & d'Agathe, c'est la grand Moule de Magellan." There is no doubt the Linnean name *perna* has to be used for the South American species. Ihering (1900) uses *Mytilus perna* Linné for the Brazilian species *(Mytilus achatinus* Lamarck, Lamy 1936), which perhaps may be conspecific with the Magellanian form. In fact, Lamy (1936) reports M. *achatinus* from the Strait of Magellan and M. *elongatus* Chemnitz from Brazil. Carcelles (1950, 1951) does not mention this species in his lists.
Occurrence: No information available.
Distribution: Strait of Magellan north to ? on the Atlantic coast of South America.

Genus CHOROMYTILUS Soot-Ryen 1952

Choromytilus Soot-Ryen, Rev. Soc. Malacolog. "Carlos de la Torre," vol. 8, no. 3, 1952, p. 121.
Type of genus: Mytilus chorus Molina 1782 (orig.).
Remarks: This group was described mainly because the resilial ridge is compact and this makes it easily separable from *Perna.* There are, however, other characters which separate these species from related groups. The posterior byssus and foot retractors are continuous though sometimes only narrowly connected; the anterior retractor is strong, very strong and elongated in *C. palliopunctatus,* and fastened to the valves approximately below the middle of the ligament. The tentacles on the posterior mantle margin are large and branched, and the valves are usually punctate inside the ventral half. The anterior adductor, wanting in larger specimens, may be seen in young specimens. The byssus is very strong, branching from a central stem. The lunule is bent inwards, forming one central tooth in the right valve corresponding to a groove in the left valve.

Species belonging to *Choromytilus* are so far reported from the American west coast from the Gulf of California south to the Strait of Magellan; South Africa, and the Kerguelen Islands.

Key to the west American species:

Shell regular, not inflated, anterior retractor oval, before the middle of the ligament	*chorus* (Molina)
Shell irregular, inflated, anterior retractor large, reaching forward from behind the middle of the ligament	*palliopunctatus* (Carpenter)

Choromytilus chorus (Molina) 1782

Plate 2, figs. 7-8; text-fig. 5

Mytilus chorus Molina, Saggio sulla Storia Naturale del Chili, 1782, p. 202.

Syn.: Mytilus albus Molina 1782.
Mytilus latus Lamarck 1819, *non* Linné 1758.
Mytilus ungulatus Lamarck 1819, *non* Linné 1758.

Holotype: ?

Type loc.: Chile.

Remarks: Molina (1782) says that this species can reach a length of seven inches and a height of 3.5 inches. It is stated to be good eating and the distribution is given as from Isla Quiriquina to the coast of the Golfo de Arauco.

This species has often been confounded with *Mytilus edulis chilensis* Hupé. The figure of the inside of the shell shows the essential characters separating this species from all other related forms.

Occurrence: Very little is known of the habitat of this species. It is commonly used for food in Chile, but apparently the fishermen have to use some special gear to catch it, as no records indicate an intertidal occurrence.

Distribution: Pacasmayo, Peru, south to Orange Bay, Tierra del Fuego.

Choromytilus palliopunctatus (Carpenter) 1855

Plate 1, fig. 5; text-figs. 4, 13

Mytilus palliopunctatus Carpenter, Catalogue of the Reigen Collection of Mazatlan Mollusca, 1855, p. 118.

Holotype: British Museum.

Type loc.: Mazatlán, Mexico.

Remarks: This is a remarkable species, as the retractor muscles are extremely strong and the tentacles on the mantle margin very large. The posterior retractors are only narrowly connected with the adductor dorsally, and the muscle-bundles lie almost horizontally toward the byssal groove, which is in the anterior third of the shell. The anterior retractor is placed below the ligament in the anterior third of the valves. The tentacles on the posterior part of the mantle are formed as broad stems with three to five branches, each furnished with numerous papillae. Between the main stems is one small tentacle, like one branch of the large ones. The dorsal siphon is long and slightly protruding.

The byssus is very strong. From a solid, round central stem, strong round branches extend to all sides. The foot is small, flattened below and furnished with a continuous slit. Behind the foot the visceral mass is seen penetrating halfway down into the mantle cavity.

The shell ordinarily is very worn, with the dark periostracum preserved on the younger parts only. The shell substance is worn off in several planes, forming different irregular keels on the anterior part. The ventral margin is bent slightly inward anteriorly.

Young *Choromytilus palliopunctatus* are sometimes very like small *Semimytilus algosus* (Gould), as they have a small anterior adductor; but the large anterior retractor easily separates them.

Occurrence: This species seems to be intertidal, living fastened to rocks and apparently on exposed coasts. The strong byssus and the worn shells seem to indicate that they are able to withstand heavy surf.

Distribution: Bahía de la Magdalena, Baja California, to Puerto Piñas, Panama.

Genus AULACOMYA Mörch 1853

Aulacomya Mörch, Catalogus Conchyliorum quae reliquit D. Alphonso d'Aguirra & Gadea, comes de Yoldi. Fasc. secundus. Acephala, 1853, p. 53.

Type of Genus: Mytilus magellanicus Chemnitz 1785 p. p. = *Mytilus ater* Molina 1782 (subsequent designation by Ihering 1900).

Remarks: Under *Aulacomya nob.* Mörch gave two species, *magellanicus* Chemnitz and *crenatus* Lamarck, Enc. Pl. 217 f. 3, both listed as from "Am. mer." and considered to be conspecific. Though *M. magellanicus* Chemnitz contained originally also *Mytilus exustus* Linné, the designation of *magellanicus* as the type of *Aulacomya* seemed to be valid.

Aulacomya is a distinct group. The outer form of the species is like other mytiliform species and is quite variable. Usually there are strong radiating striae over most of the surface, but sometimes, especially in specimens from more northern localities, the striae may be very indistinct. . . . The hinge consists of a broadly folded and turned up toothlike lunule in the left valve, with a corresponding depression in the right one. The nymphae are strong anteriorly and the resilial ridge compact. The anterior adductor is always distinct in small specimens but often obsolete or absent in larger ones *(ater)*. The anterior retractor is elongate, behind the umbones; the posterior retractors are broadly united with the adductor. The posterior part of the mantle is furnished with tentacles.

This genus comprises three species occurring on both sides of South America, South Africa, Kerguelen Island, and New Zealand.

Aulacomya ater (Molina) 1782

Plate 1, fig. 6; text-figs. 17-18

Mytilus ater Molina, Saggio sulla Storia Naturale del Chili, 1782, p. 202.

Syn.: Mytilus magellanicus Chemnitz 1785 *pro parte,* Lamarck 1819, *non* Röding 1798.

Mytilus bidens Dillwyn 1817, *non* Linné 1767.

Mytilus decussatus Lamarck 1819.

Mytilus crenatus Lamarck 1819.

Mytilus americanus Orbigny 1846.

Mytilus pyriformis Gould 1850.

Mytilus orbignyanus Hupé 1854.

Holotype: ?

Type loc.: Strait of Magellan.

Remarks: Chemnitz (1785, pp. 162-165), who introduced the name *Mytilus magellanicus* on his Pl. 83, figs. 742-743, for what undoubtedly must be this species, has confounded it with *Mytilus exustus* Linné. Molina (1782) mentions the large and the small Magellanic mussel as different from *ater,* followed by Röding (1798), who used the name *Mytilus magellanicus* for Chemnitz' fig. 738 (Pl. 83), which is *Perna perna* (Linné) = *Mytilus elongatus* Chemnitz 1785. Molina (1782) has given a short but sufficient description of his *ater:* "Mytilus testa sulcata, postice squamosa," and says that it grows nearly as large as *Mytilus chorus* and is like a *Pinna* with an obscure blue color.

There have been many different views as to what Molina's *ater* really is. Dall (1909) mentions *ater* as a separate species resembling *Mytilus edulis,* but Lamy (1936) considers it to belong to *Mytilus americanus*

Orbigny and *Mytilus magellanicus* Chemnitz. Some authors consider *ater* to be the dark variety with obsolete radial ribs, mainly the more northern forms, but there seems to be no foundation for this supposition.

Aulacomya ater is an extremely variable species, like the other shallow water mytilids. The young shells are yellowish, sometimes with a bluish prodissoconch, and with distinct radiating ridges. The outline varies, sometimes curved, sometimes with a straight ventral margin or with the ventral margin convex. Older specimens become darker, with brown or bluish-black periostracum. The darkest specimens with very weak radiating ridges seem to be found especially in the northern parts of South America.

The mantle is furnished with numerous small tentacles posteriorly. The septum is usually as long as the dorsal siphonal opening and slightly thickened in the middle. Some large specimens show a distinct scar for the anterior adductor, while this usually is obsolete in older specimens.

Occurrence: This species is reported from the intertidal zone down to at least 8 fms. The bottom is given as sand or sand and kelp, but apparently the specimens had been fastened to stones.

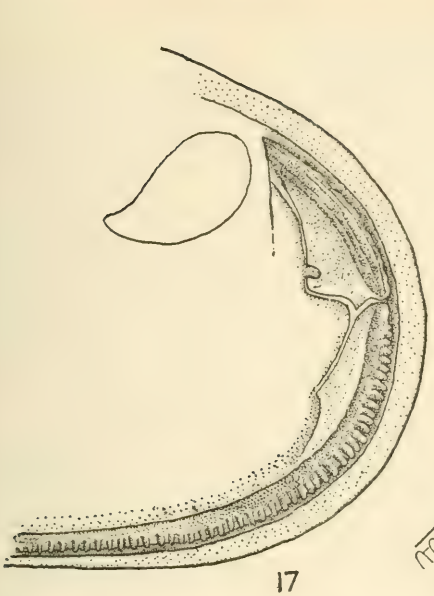
Distribution: A. ater lives from Callao, Peru, south to the Strait of Magellan, and on the east coast north to southern Brazil, and in the Falkland Islands. (This is not *M. ater* Dall (1909), Soot-Ryen (1932), which probably can be referred to *Mytella falcata* (Orbigny).)

Genus **ISCHADIUM** Jukes-Browne 1905

Ischadium Jukes-Browne, Proc. Malacol. Soc. London, vol. 6, 1905, p. 223.

Type of genus: Mytilus hamatus Say 1822=*recurvus* Rafinesque 1820 (orig.).

Remarks: Ischadium was described by Jukes-Browne (1905) as a subgenus of *Brachidontes* mainly because of the radiating sculpture. There are, however, so many characters that separate it from *Brachidontes* that there seems to be no reason why it should not be treated as a separate genus. This genus is characterized by the broad mytiliform shape with distinct radial sculpture over all the surface; the margins are crenulated, but the strong crenulations behind the ligament are absent; the hinge teeth are much like those of *Mytilus s. s.;* and the anterior retractor is roundish behind the umbones, the posterior retractors broadly united with the adductor. The mantle margins are smooth, without papillae. Apparently the genus is monotypic.



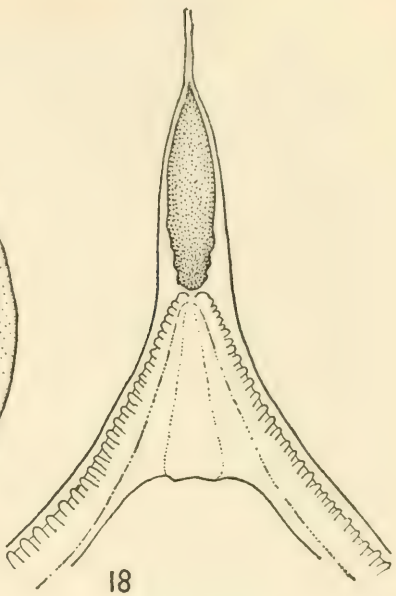
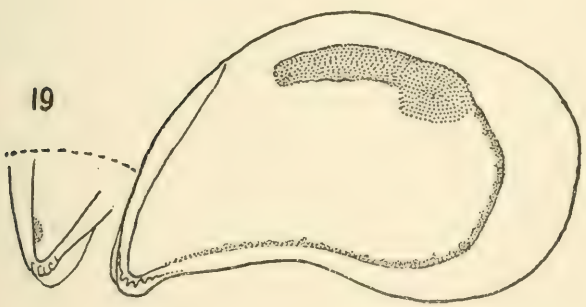


Fig. 17. *Aulacomya ater* (Molina). Off Middle Chincha Island, Peru. Posterior part of mantle.

Fig. 18. *Aulacomya ater* (Molina). Off Middle Chincha Island, Peru. Posterior part of mantle with dorsal opening seen from behind.



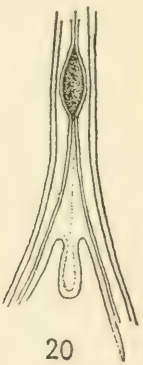


Fig. 19. *Ischadium recurvus* (Rafinesque). Santa Rosa Sound, Florida. No anterior adductor, broadly united posterior retractors and posterior adductor.

Fig. 20. *Ischadium recurvus* (Rafinesque). Santa Rosa Sound, Florida. Posterior part of mantle seen from behind, with long median flap of the septum.

Ischadium recurvus (Rafinesque) 1820

Text-figs. 19-20

Mytilus recurvus Rafinesque, Ann. gén. des Sci. Physiques, vol. 5, 1820, p. 320.

Syn.: Mytilus hamatus Say 1822.

Holotype: ?

Type loc.: ?

Remarks: The posterior part of the mantle is closed by a rather long septum with a long narrow median tongue, the dorsal opening rather short. The shell characters are those given for the genus and this species is easily recognized.

Occurrence: Reported by Dr. Tremper as collected from Newport Bay, California, one living specimen identified by Dr. Dall. It has not been observed later and the record may probably be due to an error, perhaps a misidentification of *Arcuatula demissa* (Dillwyn) (cfr. discussion in the Minutes of the Conchological Club of Southern California, no 36, June, 1944, p. 11).

Distribution: Newport Bay, California? Atlantic: Rhode Island to West Indies, Gulf of Mexico.

Genus **HORMOMYA** Mörch 1853

Text-figs. 21, 23

Hormomya Mörch, Catalogus Conchyliorum quae reliquit D. Alphonso d'Aguirra & Gadea, comes de Yoldi. Fasc. secundus. Acephala, 1853, p. 53.

Type of genus: Mytilus exustus Linné 1758 (subsequent designation by Jukes-Browne 1905).

Remarks: Mörch gave no description of his supraspecific group, but listed three catalogue numbers, of which one species, the later type of the genus, was properly named. *Hormomya* was used earlier as a subgenus of *Mytilus* because of the anteriorly placed umbones, but Jukes-Browne (1905) placed it as a subgenus of *Brachidontes* because of the sculpture. There are several other characters which separate species of *Hormomya* from *Brachidontes,* and seem to necessitate a generic separation, at least until a study of many species of this group has been made.

The type of the genus, *Mytilus exustus* Linné, an Atlantic species ranging from North Carolina to the West Indies, has anterior umbones with four or five teeth, of which the anterior ones are the strongest, and a few crenulations along the anterior part of the ventral margin. The

posterior part of the ventral margin and the posterior and dorsal margins are crenulate, with some stronger crenulations behind the ligament. The posterior retractors are not fastened to the dorsal part of the adductor, but slightly below, so the dorsal margin of the adductor is higher than the retractors. This is not always discernible from the muscle scars.

The radial sculpture on the ventral part of the shell below the strong keel is not simply bifurcating, but usually has four or five separate lines arising from one radiating line. This is best seen in the oldest parts of the shell, and when properly observed is a fairly good character for separating species of *Hormomya* from *Brachidontes*. The same pattern of the radiating sculpture is also found in *Septifer*. The posterior part of the mantle margins is furnished with small, apparently very contractile, papillae.

If *Hormomya* is restricted to species with anterior umbones, strong umbonal keel, unilateral bifurcating lines or ribs on the ventral part, and the posterior retractors placed slightly below the dorsal margin of the posterior adductor, there seem to be only two west American species referable to this genus. Sometimes more aberrant specimens with apparently subterminal umbones and a curved anterior margin may be very difficult to place in the correct group, but usually the distinct umbonal keel separating a coarsely sculptured dorsal part from the finer sculptured ventral part, shows that the specimen belongs to *Hormomya*.

Key to the west American species:

The radiating ribs at least partly ornamented with distinct round granules, older specimens with very curved and inflated anterior part	*granulata* (Hanley)
The radiating ribs more or less smooth or furnished with transverse ridges, dorsal ribs usually much coarser than the ventral ones	*adamsiana* (Dunker)

Hormomya adamsiana (Dunker) 1856

Plate 3, fig. 11; text-figs. 22, 25, 31

Mytilus adamsianus Dunker, Proc. Zool. Soc. London, vol. 24, 1856, p. 360.

Syn.: Mytilus bifurcatus auct.

Mytilus stearnsi Pilsbry and Raymond 1898.

Holotype: British Museum.

Type loc.: Isthmus of Panama.

Remarks: The species to which Dunker's name *adamsiana* is applied is extremely variable and may perhaps constitute a mixture of two or more species. It has been impossible to solve the question with the material at

hand, but it is to be hoped that students will try to settle the problem in the future. There has been much discussion about this species, both in regard to the distinction of it and the proper name for it. Dunker's description fits one form only and should not be used for the many other heavily sculptured forms. The real *Hormomya adamsiana* should be of a dark purplish color and furnished with bifurcating ribs elegantly granulated. Pilsbry and Raymond (1898) introduced the name *Mytilus stearnsi* for the California species called *Mytilus bifurcatus* and in appearance very like *Septifer bifurcatus* (Conrad), with the type locality for *M. stearnsi* given as San Diego. In spite of these disagreements, I think it safest at the present time to use *adamsiana* Dunker for the variable complex of *Hormomyas* living along the Pacific coast of America from Santa Barbara, California, to Ecuador. There might be a possibility that Dunker's name should be used for another species, perhaps for *Mytilus puntarenensis* Pilsbry and Lowe, 1932, which has to be placed in the genus *Brachidontes*.

Fig. 21. *Hormomya exusta* (Linné). Long Key, Florida. Hinge of left and right valves.

Fig. 22. *Hormomya adamsiana* (Dunker). Isthmus Cove, Santa Catalina Island. Showing insertion of retractors in the posterior adductor.

Fig. 23. *Hormomya* sp. Sculpture on the ventral side, showing unilateral furcation. a. Enlarged part.

Fig. 24. *Brachidontes* sp. Sculpture on the ventral side showing bifurcation. a. Enlarged part.

Fig. 25. *Hormomya adamsiana* (Dunker). Isthmus Cove, Santa Catalina Island, California. Hinge.

Fig. 26. *Hormomya granulata* (Hanley). Bahía de la Independencia, Peru. Hinge.

Fig. 27. *Brachidontes modiolus* (Linné). Lower Matecumbe, Florida. Hinge of left and right valves.

Fig. 28. *Brachidontes multiformis* (Carpenter). Mazatlán, Sinaloa, Mexico. Hinge.

Fig. 29. *Brachidontes puntarenensis* (Pilsbry and Lowe), Punta Arenas, Costa Rica. Paratype. Hinge.

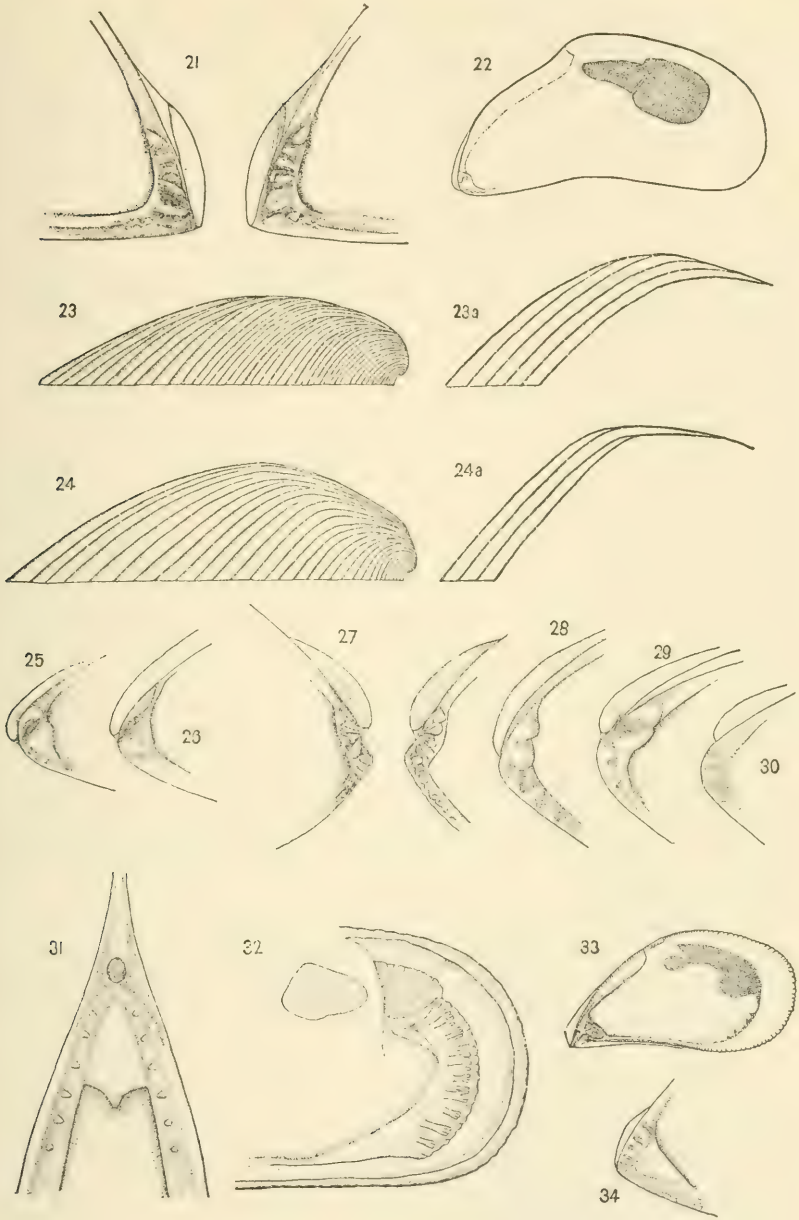
Fig. 30. *Brachidontes purpuratus* (Lamarck). Bahía de la Independencia, Peru, Hinge.

Fig. 31. *Hormomya adamsiana* (Dunker). Puerto Parker, Costa Rica. Mantle with dorsal opening, septum, and the small mantle papillae seen from behind.

Fig. 32. *Brachidontes modiolus* (Linné). Lower Matecumbe, Florida. Posterior part with tentacles on the mantle.

Fig. 33. *Septifer bifurcatus* (Conrad). San Pedro, California. Inside of right valve with the anterior septum for the adductor muscle, and the posterior adductor embracing the retractors.

Fig. 34. *Septifer zeteki* Hertlein and Strong. Off Colombia. Hinge and septum of right valve.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H. adamsiana is so like some of the forms of *Septifer bifurcatus* that the shells have to be opened to make the identification quite certain.
Occurrence: Intertidal on rocky shores.
Distribution: Ecuador to Santa Barbara, California, including the Gulf of California and the Galapagos Islands.

Hormomya granulata (Hanley) 1843

Plate 3, fig. 12; text-fig. 26

Mytilus granulatus Hanley, Catalogue of Recent Bivalve Shells, 1843, p. 246, Pl. 24, fig. 33.
Holotype: British museum.
Type loc.: South America.
Remarks: This is the typical South American *Hormomya* living along rocky coasts. The color is yellowish-brown and the radiating ribs, which are of approximately the same width as the interspaces, are furnished with round granules, easily seen in side view. Large specimens are usually more inflated, with the anterior part strongly curved, giving the shells an odd appearance. The hinge is variable, but the right valve usually has three, the left valve two, stronger teeth. The posterior part of the mantle is furnished with papillae and the septum has a rather long median flap.
Occurrence: Intertidal, fastened to rocks.
Distribution: Lobos, Peru, to southern Chile.

Genus SEPTIFER Recluz 1848

Septifer Recluz, Revue Zool., 1848, p. 275.
Type of genus: Mytilus bilocularis Linné 1758 (subsequent designation by Stoliczka 1871).
Remarks: Species of this genus generally are very like *Hormomya* species, but they are easily separated by the anteriorly placed deck or septum for the anterior adductor. For some species, such as the California *Septifer bifurcatus,* it is necessary to open the shells before a determination can be made.

The outer form, sculpture, marginal crenulations, and hinge are very like those of *Hormomya,* and the mantle is armed with tentacles or papillae like those found in *Hormomya* species. The septum seems to grow out in the same way as the thick, elevated adductor scar in *Hormomya* or *Brachidontes,* since the anterior adductor becomes very narrow in shells with the ventral side flattened. The posterior adductor embraces the retractors dorsally, so these scars are different from *Hormomya.*

Species of *Septifer* are recorded from the Cretaceous. The recent spe-

cies are found mainly in tropical or subtropical waters. From the west coast of America only two species are recognized, as the statement of Clessin (1889) that *Septifer crassus* Dunker 1853 should be found in Peru is erroneous. There is, however, a possibility that specimens referred to *S. bifurcatus* Conrad constitute more than one species.

Key to the west American species:

Periostracum strong, dark, without hairs; ribs generally strong, irregular, hinge with at least one single or compound large tooth	*bifurcatus* (Conrad)
Periostracum thin, light-colored, with long hairs; ribs fine, granulated; hinge with smaller teeth; light and bright-colored small species	*zeteki* Hertlein and Strong

Septifer bifurcatus (Conrad) 1837

Plate 4, figs. 19-20; text-fig. 33

Mytilus bifurcatus Conrad, Jour. Acad. Nat. Sci. Phila., vol. 7, 1837, p. 241, Pl. 18, fig. 14.

Holotype: lost.

Type loc.: Sandwich Islands, ?California.

Remarks: From Conrad's short description it is impossible to tell if his species is a *Septifer* or not. The color of his shell is stated to be dark purple and the habitat Sandwich Islands (Ouau, etc.). Carpenter (1864, p. 527) says: "The type is lost; the figure and description would suit many species. It is allocated, in Mus. Cum., to the Californian *Septifer;* but by Pease to a Sandwich Island *Mytilus.*"

Though the type may have nothing to do with the Cuming Collection, the name *bifurcatus* has been used for the California *Septifer*. Dunker (1853) used the name *Mytilus trifurcatus*. Pilsbry and Raymond (1898) say that specimens of *Mytilus bifurcatus* described by Conrad and collected by Nuttall were presented to the Academy of Natural Sciences in Philadelphia, where they are still preserved. They probably were collected in California and they proved to be *Septifer*. But the allocation of the name *bifurcatus* to the genus *Septifer* cannot be said to be settled.

The outer form of this species is as variable as that of other intertidal mytilids. The keel from umbo to posteroventral angle is generally very pronounced and the ventral part flattened. The radiating sculpture is strong posterior to the keel, with the upper ribs bent dorsalward; the ventral ribs are weaker; all ribs are irregularly furcating. The periostracum is dark, blackish. The anteriorly placed umbones are strongly

twisted, with the lunule bent inward, at least in large specimens, and furnished with radiating furrows which form the teeth. Generally there is a single strong tooth more or less furrowed; but the teeth seem to be so variable that it is nearly impossible to give an adequate description of them. The margins are crenulated, with especially strong crenulations behind the ligament. The crenulations on the posterior margins are extremely variable.

The color of the interior is either whitish-gray or dark purplish, sometimes lighter anteriorly. The crenulations on the posterior margin are very fine on the dark-colored shells, while on the light-colored they are very often formed by the external ribs only. The number and form of the tentacles and papillae on the posterior mantle margin vary also, the tentacles being sometimes simple, sometimes digitate, with smaller papillae in between. All characters vary so much that a large amount of material will be needed to be able to decide if there is more than one species or not. The form with nearly smooth posterior part of the valves, named *S. bifurcatus obsoletus* by Dall, 1916, is found mixed with more heavily ribbed forms and seems not to be of subspecific value.

Occurrence: Usually intertidal, fastened to rocks.

Distribution: From Crescent City, California (42° N), south to Cabo San Lucas, Baja California. (One sample is labelled "Peru," but this is certainly wrong.)

Septifer zeteki Hertlein and Strong 1946

Plate 4, fig. 21; text-fig. 34

Septifer zeteki Hertlein and Strong, Zoologica, vol. 31, 1946, p. 71, Pl. 1, figs. 1-2.

Syn.: Septifer cumingii Recluz 1849.

Mytilus cumingianus Reeve 1858.

Holotype: California Academy of Sciences. Paleo. Type Coll.

Type loc.: Isla Taboga, Panama; 25 fms.

Remarks: Recluz (1849) described *S. cumingi* from "les côtes de l'île Annaa (près le détroit de Panama), dans l'Océan-Pacifique." Reeve (1858) records *M. cumingianus* from Panama. Carpenter (1855) says that this species, which he reports from Mazatlán, is extremely rare and closely resembles the young of *S. bilocularis*. He also mentions the "granulose ribs, with rather long bristly hairs rising up between." Mörch (1860) reports this species from Puntarenas, Costa Rica. Smith (1885) says: "The small shells described by Recluz as *Septifer cumingii* should not, I think, be separated from this species [*S. bilocularis*]" and remarks

that the only island "Annaa" he knows is in Polynesia. Because of these doubts, Hertlein and Strong have given the species a new name. There may have been a wrong locality attached to Cuming's type lot, as was often the case, and then the oldest name should be retained.

This species is easily recognized by the light and varying colors and the hairy periostracum. The apical septum is rather shallow, especially in small specimens. The largest specimen measured has a length of 11.8 mm.

Occurrence: While loose valves are found at many stations, living specimens seem to be rare. They are usually found on rocky or stony bottom from the shore down to 50 fms. The material at hand extends the distribution considerably.

Distribution: From Isla de Cedros, Baja California, south to Isla La Plata, Ecuador; Galapagos Islands.

Genus **BRACHIDONTES** Swainson 1840

Text-figs. 24, 27, 32

Brachidontes Swainson, A Treatise on Malacology, 1840, p. 384.

Type of genus: Modiola sulcata Lamarck 1819 (not 1805) = *Mytilus citrinus* Röding 1798 = *Arca modiolus* Linné 1767.

Remarks: The original description is: "Umbones prominent, not terminal; valves corrugated; hinge margin considerably angulated, teeth many, small, and crenate." The hinge of the Atlantic *Brachidontes modiolus* (Linné) shows three large teeth radiating from the umbones and a series of crenulations on the anterior margin, which continue the hinge in a different angle. This species seems not to fit the diagnosis completely and there might perhaps be some doubt as to what Swainson's *sulcata* really was.

As stated under *Hormomya,* species referred to this genus have simple bifurcating sculpture, the posterior retractor fastened along the dorsal part of the adductor, not quite terminal umbones, a more or less angulated anterior margin, and toothlike crenulations behind the ligament. Some of these characters may be very difficult to observe, but usually species of *Brachidontes* are easily separable from *Hormomya.* The posterior mantle margin is furnished with branched tentacles, though a branching apparently is not developed in some of the species. The tentacles or papillae are very contractile and sometimes difficult to see. It seems to be possible to separate five species occurring from Mexico south to the Strait of Magellan, but the distinctive characters are not convincing. Some specimens are

very difficult to place and I must admit that now and then some characters are more like *Hormomya* than *Brachidontes*. Perhaps there still might be unrecognized species of this genus, too.

Key to the west American species:

1. Sculpture obsolete on the ventral side, sometimes the whole surface nearly smooth, the length usually less than 12 mm — *multiformis* (Carpenter)
   Sculpture more uniform, also on the ventral side — 2
2. Coarsely ribbed species of variable outline, purplish with heavy black periostracum, and a series of small teeth — *purpuratus* (Lamarck)
   Sculpture finer, periostracum lighter, outline more constant, some of the teeth larger than the crenulations — 3
3. Umbonal keel flat, shell not inflated, sculpture uniform over all the shell, ribs fine and close-set, shells stained yellowish-brown, anterior margin broadly rounded — *playasensis* (Pilsbry and Olsson)
   Umbonal keel usually distinct and shell inflated, sculpture obsolete or weaker on the ventral side, anterior margin narrow — 4
4. Larger species to 17 mm of regular form — *puntarenensis* (Pilsbry and Lowe)
   Smaller species to 10 mm of irregular form — *houstonius* Bartsch and Rehder

Brachidontes multiformis (Carpenter) 1855

Plate 3, fig. 13; text-fig. 28

Mytilus multiformis Carpenter, Catalogue of the Reigen Collection of Mazatlan Mollusca, 1855, pp. 118-120.

Syn.: ?Modiola semilaevis Menke 1849.

Holotype: British Museum.

Type loc.: Mazatlán, Mexico.

Remarks: Carpenter's description seems to have been based on what here is considered to be the true *multiformis* and on small heavily sculptured

Hormomya adamsiana. There appears always to be a smooth or obsoletely sculptured part behind the lunule; and the dorsal sculpture sometimes consists of distinct, but not exceptionally coarse, radiating ribs. The sculpture usually is fine and sometimes completely absent. The color varies from dark purple or brown dorsally to yellowish, white, or greenish-olive ventrally. The hinge is furnished with one to three, usually two, dark purplish larger teeth. Maximal length of specimens at hand is 13.2 mm.
Occurrence: Intertidal among algae.
Distribution: From the northern part of the Gulf of California and Punta Rosarita, Baja California, to Ecuador.

Brachidontes purpuratus (Lamarck) 1819

Plate 4, fig. 18; text-fig. 30

Modiola purpurata Lamarck, Animaux sans vertèbres, vol. 6, part 1, 1819, p. 113.
Syn.: ?Mytilus ovalis Lamarck 1819.
?Mytilus exilis Philippi 1847.
?Mytilus exaratus Philippi 1847.
Mytilus bifurcatus Dautzenberg 1896.
Holotype: lost.
Type loc.: ?
Remarks: This species is extremely variable in form, sculpture, and color. Usually larger specimens are more or less worn, white on the beaks and on the anteroventral part, otherwise purplish with traces of the blackish periostracum. Large specimens of 40 mm in length are not uncommon. The hinge consists of several crenulations of nearly equal size and thus fits the description of *Brachidontes* much better than that of what was considered to be the type species.

The papillae on the posterior part of the mantle are puzzling, as they are sometimes quite distinct but usually seem to be completely absent. The retractor scars are often separated into several parts, usually six for the posterior muscles and two for the anterior ones. The anterior adductor scar is often very thick and raised above the main interior surface, simulating a "septum" to some degree. The marginal crenulations vary a great deal, but there are always distinct tooth-like crenulations behind the ligament.
Occurrence: Intertidal on rocky shores.
Distribution: Ecuador south to the Strait of Magellan. Atlantic north to Santa Cruz, Argentina.

Brachidontes playasensis (Pilsbry and Olsson) 1935

Pl. 3, fig. 16

Modiolus (Brachydontes) playasensis Pilsbry and Olsson, Nautilus, vol. 49, 1935, p. 17, Pl. 1, fig. 4.

Holotype: Academy of Natural Sciences of Philadelphia. No. 164617.

Type loc.: Playas, Santa Elena, Ecuador.

Remarks: This species is characterized by the fine radial sculpture of nearly the same strength over the whole surface and by the light brown color arranged on a white shell, partly concentric and partly in irregular blotches. The radial striae seem not to bifurcate except along the extreme dorsal and posterior margins, but the striae grow broader from the nearly smooth oldest part of the shell. There are fine, close-set concentric lines which cross the ribs and interspaces. The margins are finely crenulated except on the anterior part of the ventral margins. There are three teeth diverging from the umbones; the anterior margin is bent outward proximally and crenulated. The muscle scars are indistinct, the anterior adductor seems to be placed along the anterior border, which protrudes slightly beyond the umbones.

There might be some doubt if the specimen here referred to *B. playasensis* really is this species. The figure of the type of *playasensis* shows a shell very like *Brachidontes puntarenensis* in outline but apparently with a finer sculpture. The main difference between these two species seems to be that the sculpture is obsolete anteriorly in one but distinct in the other.

Occurrence: No data available.

Distribution: Ecuador.

Brachidontes puntarenensis (Pilsbry and Lowe) 1932

Plate 3, fig. 14; text-fig. 29

Mytilus (Hormomya) puntarenensis Pilsbry and Lowe, Proc. Acad. Nat. Sci. Phila., vol. 84, 1932, p. 104, Pl. 10, fig. 6.

Holotype: Academy of Natural Sciences of Philadelphia. No. 155629.

Type loc.: Puntarenas, Costa Rica.

Remarks: Through the kindness of Mr. E. P. Chace, a sample of the paratypes from the San Diego Museum was studied. Though the authors described it as a *Hormomya* and compared it to *Mytilus exustus,* this species belongs to the genus *Brachidontes.* The anterior margin is narrow, but the angulation in the hinge is observable, the muscle scars and the radial sculpture agree with *Brachidontes* as here interpreted. There might be a possibility that Dunker used the name *Mytilus adamsianus*

for this species and not for the *Hormomya.* It is closely related to *Brachidontes playasensis* and *Brachidontes houstonius* and perhaps the three species are local forms of one more variable species.
Occurrence: Stated to be common at the type locality, apparently intertidal.
Distribution: Puntarenas and Puerto Parker, Costa Rica.

Brachidontes houstonius Bartsch and Rehder 1939

Plate 3, fig. 15

Brachidontes multiformis houstonius Bartsch and Rehder, Smithsonian Miscellaneous Collections, vol. 98, no. 10, 1939, p. 14, Pl. 4, figs. 4-7.
Holotype: United States National Museum. No. 472858.
Type loc.: Bahía de Sulivan, Isla Santiago (James Island), Galapagos Islands; shore.
Remarks: This species was described as a finer sculptured subspecies of *Brachidontes multiformis,* assuming that the heavily ribbed specimens from Central America (here considered to be forms of *Hormomya adamsiana* (Dunker)) represented Carpenter's species. *B. houstonius* is very like *B. puntarenensis* from Costa Rica and might well be considered a smaller race of that species. The material studied is too small to allow a settlement of this question.
Occurrence: Intertidal on rocky shore.
Distribution: Galapagos Islands.

Genus **MYTELLA** new genus

Diagnosis: Shell of varying outline from mytiliform through modioliform to very elongate. Umbones subterminal or nearly terminal. Anterior margin smooth or furnished with three or four teeth, and the lunule radiately sculptured, the sculpture consisting of fine or coarse concentric lines. The dorsal part usually greenish and the ventral part yellowish or brown, with the greenish color sometimes concealed by darker color. The resilial ridge pitted like *Mytilus s. s.,* but sometimes so narrow that the pittings are obsolete. Anterior adductor rather large, anterior retractor placed before or behind the umbonal cavity, and a distinct small scar seen between the anterior retractor and adductor scars. Posterior adductor confluent with the posterior retractor. The two posterior retractors widely separated, but the scars usually continuous; a small scar below the adductor, made by the mantle muscles. The posterior part of the mantle furnished with branching tentacles; the dorsal opening with smooth margins.

Type of genus: Modiola guyanensis Lamarck 1819.

Remarks: Though one of the species tentatively included in this new genus is mytiliform as to teeth, there are several distinct characters which easily separate the species of this genus from other mytilids. The green color, the pitted resilial ridge, and the rounded anterior retractor scar with the distinct scar below, are the most important shell characters; while the tentacles on the posterior pallial margin and the widely separated posterior retractor muscles are important characters of the soft parts. Two species, *Mytella falcata* (Orbigny) and *Mytella guyanensis* (Lamarck), live on both sides of Central America, while *Mytella speciosa* (Reeve) is restricted to the Pacific, and *Modiola papyria* Conrad, which perhaps should be placed in this group, is found on the Atlantic side only. The fossil species named *inezensis* by Conrad and the more northern *restorationis* van Winkle seem to belong to this genus also.

Key to the west American species:

1. Mytiliform with nearly anterior umbones and usually with distinct teeth and radiately sculptured lunule — *falcata* (Orbigny)
   Modioliform with smooth anterior margins and not terminal umbones — 2

Fig. 35. *Mytella falcata* (Orbigny). Laguna de Chacahua, Oaxaca, Mexico. Anterior retractor behind the umbo, a small scar just above the anterior adductor, distinct and apparently continuous scars of the posterior retractors.

Fig. 36. *Mytella guyanensis* (Lamarck). San Felipe, Gulf of California. Anterior retractor in umbonal cavity, a small scar just below the retractor scar, narrow and apparently continuous scars of the posterior retractors.

Fig. 37. *Mytella speciosa* (Dunker). Bahía de la Magdalena, Baja California. Anterior retractor before the umbo, a small scar between the retractor and the adductor scars, posterior retractor and adductor scars weak.

Fig. 38. *Mytella falcata* (Orbigny). Laguna de Chacahua, Oaxaca, Mexico. Posterior part of the mantle with papillae.

Fig. 39. *Mytella falcata* (Orbigny). Laguna de Chacahua, Oaxaca, Mexico. The muscles of the foot and byssus, anterior retractor slender, posterior retractors of the foot divided into two branches.

Fig. 40. *Mytella falcata* (Orbigny). Laguna de Chacahua, Oaxaca, Mexico. Enlarged part of the papillae of the mantle.

Fig. 41. *Mytella guyanensis* (Lamarck). San Felipe, Gulf of California. Posterior part of the mantle with papillae.

Fig. 42. *Mytella guyanensis* (Lamarck). San Felipe, Gulf of California. Enlarged part of the papillae of the mantle from preserved specimen.

Fig. 43. *Mytella guyanensis* (Lamarck). San Felipe, Gulf of California. Enlarged part of the papillae of the mantle drawn from a living specimen.

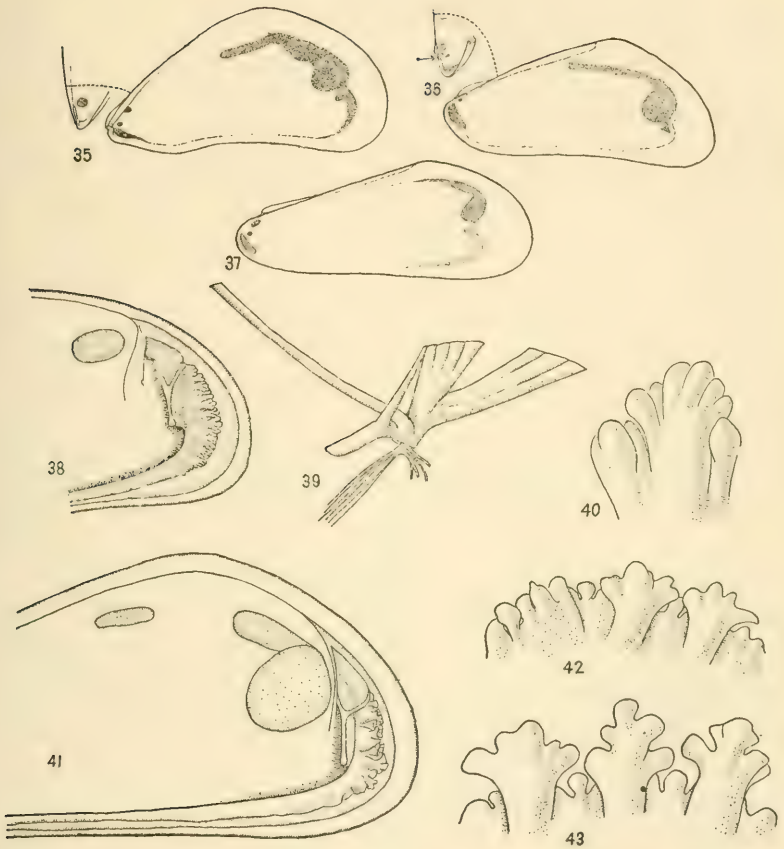
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Fig. 44. *Mytella guyanensis* (Lamarck). Distribution mainly according to samples in American museums.

2. Anterior retractor before umbo, shell thin, very elongate and nearly smooth — *speciosa* (Reeve)
   Anterior retractor behind umbo, shell thicker with concentric sculpture — *guyanensis* (Lamarck)

Mytella falcata (Orbigny) 1846

Plate 5, fig. 24; text-figs. 35, 38-40, 45

Mytilus falcatus Orbigny, Voyage dans l'Amérique Méridionale, vol. 5, Mollusques, 1846, p. 645, Pl. 84, figs. 38-39.

Syn.: ?Mytilus strigatus Hanley 1843 (Hinds MS).
Mytilus charruanus Orbigny 1846.

Modiola mutabilis auct. non Carpenter 1856.
Mytilus nitens auct. non Carpenter 1856.
Modiolus arciformis Dall 1909.

Holotype: ?

Type loc.: Rio de Janeiro.

Remarks: This extremely variable and widely distributed species is found under many different names in museum collections. There is some doubt about the oldest name for the species. If *Mytilus strigatus* Hanley, Pl. 24, fig. 34, with the description on p. 251 as of Hinds 1844, really represents the species, the name has to be changed accordingly. The original diagnosis does not mention any locality. On p. 388, Hanley says that Hinds intended to describe this species but never did it, and it has subsequently been termed *Mytilus falcatus* by Orbigny (S. Am.).

Reeve (1857) concurs with Hanley in giving the Philippine Islands as the habitat for *Modiola strigata* Hanley, and considers that *Mytilus strigatus* Hanley is the same species. Reeve's species is thought to be *Mytilus sinuatus* Reeve by Lamy (1936), who uses *Mytilus strigatus* Hanley for the Mexican species. There seems, however, to be no justification for this; so if the locality, Philippine Islands, is correct, it is safest until otherwise proved, to use *Mytella falcata* (Orbigny) for this species. Orbigny (1846) used the name *Mytilus falcatus* in the description, p. 645, but the name *Mytilus charruanus* for the figure, Pl. 84, figs. 38-39.

Carpenter (1856) described *Modiola nitens* as from California but later (1864) said: "The shell was erroneously described as from 'California' in P. Z. S., and does not appear in the Reigen Mazatlan Cat.: = *M. subpurpureus,* Mus. Cum." Dall (1909) described *Modiolus arciformis* on two fragments from Ecuador. Though these fragments represent rather arcuate specimens, they are conspecific with ordinary *Mytella falcata* and the same form is also found on the Atlanic side.

Mytella falcata has nearly terminal umbones and a short rounded anterior margin, sometimes narrow, sometimes broader. The lunule is furnished with radiating folds forming three or four teeth on the anterior margin. Usually there is a distinct dorsal angle, but sometimes the dorsal margin is evenly curved. Specimens from different localities may often appear to belong to different species. The same forms, however, are recorded from both oceans and from widely separated localities. The color usually is distinct, with yellowish-brown anteroventral part and green dorsal part. The green color may be uniform or shown as dark criss-cross bands on a lighter surface. Some populations are nearly black, but a

greenish hue is observable at least on the keel. The periostracum is more or less shining, with a narrow dull stripe along the ligament. The interior is usually dark purple.

It is easy to confuse this species with *Mytilus s. s.* The best character, aside from the color, is the round scar made by the anterior retractor, as this scar is always elongate in *Mytilus s. s.* Between the anterior adductor and retractor a small but distinct scar is seen. This scar seems to be made by a thickening of the mantle and not by a branch of the anterior retractor. The posterior *retractores bysii* are widely separated, though the scars are continuous. The foot retractor is small and attached in front of the first posterior retractor. The byssus consists of numerous fine threads from a main stem.

The posterior part of the mantle margin is folded and furnished with papillae or tentacles from the posteroventral corner upward to where the two lobes unite. The dorsal opening has smooth, slightly protruding margins. The septum terminates in a triangular flap. Mantle margins and septum are pigmented with dark brown in the specimens studied. The labial palps are very long, reaching to the foot.

Occurrence: As far as is known, this species lives in the mud on intertidal flats and in shallow lagoons down to 6 fms. One sample was taken from the bottom of a boat in the estuary of Guaya, Ecuador. The two samples from the Hancock expeditions extend the distribution north to southern Mexico.

Distribution: The northernmost Pacific record is from Bahía de Petatlán, Mexico. (One specimen in the San Diego Museum was found in a sample of *Mytella guyanensis* from La Paz, Baja California, but apparently had been misplaced.) The southernmost Pacific record seems to be the estuary of Guaya, Ecuador. A sample in the California Academy of Sciences is from Isla Baltra (South Seymour Island), the Galapagos Islands. On the Atlantic side, *Mytella falcata* is recorded from the Golfo de Paria, Venezuela, to Cabo San Antonio, Argentina.

Mytella speciosa (Reeve) 1857

Plate 5, fig. 25; text-fig. 37

Modiola speciosa Reeve, Conchologia Iconica. Modiola, 1857, Pl. 7, Species 35.

Syn.: Modiolus tumbezensis Pilsbry and Olsson 1935.

Holotype: British Museum?

Type loc.: Tumbes, Peru.

Remarks: This thin-shelled species, which is very elongate when full-grown, seems to be rather rare. Smaller specimens are very like small *Mytella guyanensis,* but they can always be separated by the difference in the position of the anterior retractor.

Mytella speciosa (Reeve) has been labelled *Modiola picta* Lamarck or *Modiola planulata* (Lamarck) in many collections.

Occurrence: Intertidal, according to Pilsbry and Olsson (1935).

Distribution: Northern Peru; Golfo de Fonseca, Nicaragua; Bahía de la Magdalena, Baja California.

Mytella guyanensis (Lamarck) 1819

Plate 5, figs. 22-23; text-figs. 36, 41-44

Modiola guyanensis Lamarck, Animaux sans Vertèbres, vol. 6, part 1, 1819, p. 112.

Syn.: Mytilus modiolus brasiliensis Chemnitz 1795.
Modiola semifusca Sowerby 1830, *non* Lamarck 1819.
Modiola sinuosa King 1831.
Modiola ?brasiliensis var. *mutabilis* Carpenter 1856.

Holotype: ?

Type loc.: Guiana.

Remarks: This widely distributed and variable species cannot, as far as is known, be separated into Atlantic and Pacific races on the basis of shell characters. The samples preserved in the various museum collections studied show the same variations in both oceans. The typical form is a beautiful shell, bright green above the keel and yellow-brown on the ventral and anterior parts, and of a high regular form. Reeve (1857) says that the more uniformly dark-colored form should be considered typical, but the dark-colored forms are very often of a more irregular outline and seem to be the same as Carpenter's var. *mutabilis.* The green color is often made up of branching green lines on a darker brownish ground color. The anterior adductor is placed high up along the anterior margin, the anterior retractor in the umbonal cavity just behind the umbones; and a small scar below is very distinct and situated halfway between the adductor and the retractor. In small specimens, the scars of the two parts of the posterior retractors may be separated; but usually these scars seem to be continuous. The interior of the shell is whitish, distinctly tinged with violet on the muscle scars and on the posterior part. The posterior part of the mantle margin is furnished with branched tentacles very like those of *Mytella falcata.*

Fig. 45. *Mytella falcata* (Orbigny). Distribution mainly according to sample in American museums.

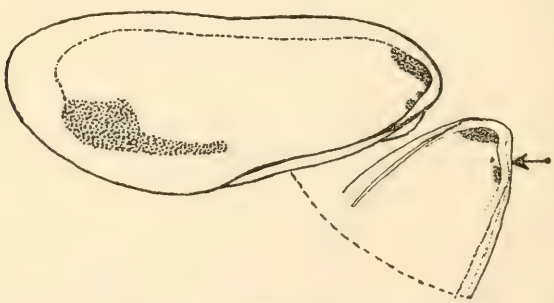

Fig. 46. *Arcuatula demissa* (Dillwyn). New London Bay, Gulf of St. Lawrence. Anterior retractor in the umbonal cavity, a small scar between the anterior adductor and retractor scars.

Occurrence: M. guyanensis is found attached to stones and nearly buried in muddy sand in the intertidal zone. The posterior part with the fringed branchial opening is above the surface of the sand.

Distribution: In the Pacific from the northernmost part of the Gulf of California south to Payta, Peru (or Sandwich Islands, Chile, according to one sample in the Museum of Comparative Zoology, Cambridge, Mass. The only Chilean Sandwich Island I know is situated in Tierra del Fuego, so either the label is wrong or there is another Sandwich Island in northern Chile.)

It is also recorded from Laguna de San Ignacio and Bahía de la Magdalena, Baja California. In the Atlantic, it is found in scattered localities from the Golfo de Paria, Venezuela, to Rio de Janeiro. One sample, also in the Museum of Comparative Zoology, is from Puerto Rico, the first record from the West Indian Islands.

Genus ARCUATULA (Jousseaume) Lamy 1919

Arcuatula (Jousseaume) Lamy, Paris. Bul. Mus. Nat. d'Hist. Nat., vol. 25, 1919, pp. 173-174.

Type of genus: Modiola plicatula Lamarck 1819 = *demissa* (Dillwyn) 1817 (orig.).

Remarks: Lamy (1919), referring to notes made by Jousseaume, says, *sub Modiola arcuatula* Hanley: "M. le Dr. Jousseaume place le *Mod. arcuatula* dans un nouveau genre *Arcuatula,* créé pour le groupe des *Modiola,* dont presques toutes les espèces sont arquées et dont la forme typique est cella du *M. plicatula* Lamarck [= *demissa* Dillwyn]: les coquilles de ce genre, dont les unes sont presque lisses et d'autres fortement striées, ont le bord du ligament très long, et l'angle formé par ce bord et le postérieur est mousse et souvent arrondi; dans le genre *Brachydontes,* au contraire, le bord du ligament est court, l'angle plus saillant et le bord postérieur souvent très long et arqué en dedans." The generic name *Arcuatula* certainly was intended to be used for *Modiola arcuatula* Hanley, but the passage given by Lamy shows that Jousseaume himself chose *Modiola demissa* as the type of the genus.

This common east coast shell has been referred to either *Modiolus* or *Brachidontes* by various authors, and definitely needs a proper generic name. The characters separating *Arcuatula* from *Brachidontes* are many, of which the lack of toothlike crenulations behind the ligament is the most conspicuous. Most of the distinctive characters are the same as those found in *Modiolus.* The adductor and the retractor scars are very like those found in some species of *Modiolus,* the posterior mantle mar-

gins are smooth without papillae or tentacles, and the outline is modioliform. Characters separating *Arcuatula* from *Modiolus* are the radial sculpture; the distinct radial folds on the lunule which make the anterior margin crenulated; the shallow form; and the weak nymphae and the relatively light ligament.

It is difficult, without a close examination of the various Pacific species assigned to *Arcuatula,* to decide if they should be referred to this genus or not.

Arcuatula demissa (Dillwyn) 1817

Plate 9, fig. 47; text-fig. 46

Mytilus demissus Dillwyn, Descriptive Catalogue of Recent Shells, vol. 1, 1817, p. 314.

Syn.: Modiola plicatula Lamarck 1819.
Modiola semicostata Conrad 1837.

Holotype: ?

Type loc.: Carolina.

Remarks: This species is easily recognized by the radial sculpture and *Modiolus*-like form. The anterior retractor has a small ventral branch; otherwise the muscle scars are very like those found in *Modiolus.* A good figure of a specimen from San Francisco Bay is given by Fitch (1953).

Occurrence: Reported from San Francisco Bay, introduced from the east coast with seed oysters. It is common on the mud flats between San Mateo and San Francisco (cfr. Hanna 1921). Mr. L. C. Bessom, Los Angeles, has found this species living intertidally, but near the high tide level, in the upper part of Newport Bay. One specimen has a length of 90 mm.

Distribution: California, San Francisco Bay and Newport Bay (introduced). Atlantic. Gulf of St. Lawrence to Florida.

Genus **MODIOLUS** Lamarck 1799

Modiolus Lamarck, Mém. Soc. Hist. Nat. Paris, 1799, p. 87.

Syn.: Volsella Scopoli 1777.
Modiola Lamarck 1801.
Perna H. and A. Adams 1858.
Eumodiolus Ihering 1900.

Type of genus: Mytilus modiolus Linné 1758 (subsequent designation by Gray 1847.)

Remarks: There have been, and still are, different opinions as to the validity of Scopoli's genus because he described *M. modiolus* Linné as

having one tooth. In fact, *Modiolus* species usually have one toothlike projection where the anterior margin stops below the ligament. This projection is easily seen in most of the specimens of every size, not only in young ones, as mentioned by Dall, Bartsch, and Rehder (1938); and the presence of this projection proves that Scopoli was a careful observer. Though the use of *Volsella* now is generally accepted, the International Commission on Zoological Nomenclature in Opinion 325, issued January 7th, 1955, has made a suspension of the rules and accepted *Modiolus* Lamarck 1799 as a *nomen conservandum* according to a motion by J. L. Baily, Jr. This change came after this paper was in print and the necessary corrections had to be made during the proof reading.

The typical *Modiolus* has a smooth, elongate shell with slightly curved ligamental margin, a curved dorsal margin without a pronounced dorsal angle, and the umbones placed slightly behind a rounded anterior margin which is bent slightly outward. The anterior adductor is elongate and placed ventrally, the anterior retractor leaves a rounded scar in or behind the umbonal cavity, the posterior adductor is placed in the upper half of the shell and is continuous with the long and narrow bundle of posterior retractors. The periostracum is heavy and furnished with hairlike protuberances, at least on the dorsal and posterior part. On the anterior margin, a lunule is visible by the dull periostracum, especially in younger specimens. The resilial ridge is compact, and the nymphae, usually strong, are rather distant from the dorsal margin, making the ligamental area broad. The dorsal siphonal opening is oval with smooth margins and does not form a siphon which can be extended; the mantle of the branchial opening is thin or thickened, but always without tentacles or papillae.

Unfortunately a multitude of species with the outline of *Modiolus* but with radiating sculpture, different placement of the muscles, or differences in the anatomy, have been referred to this genus. Many of these species show affinities to other groups, *e. g.,* to the *Musculus* group *(Lioberus),* and some should be placed in new genera. Before a more correct grouping of the species can be completed, the anatomical and conchological characters must be studied carefully. Until then, the species which are doubtfully allocated to this genus should be cited as *"Modiolus"* sp.

The *Modiolus* type can be traced back in time to the first origin of the family Mytilidae and certainly represents the oldest element of this family, or perhaps forms the continuation of the Modiolopsidae. The flatter species of *Volsellina* Newell seem to be closely related to some recent *Modiolus*-like species.

Jousseaume has, according to Lamy (1919) established three new genera for various types of *Modiolus*. Genus *Modiolatus* Jousseaume (1893) was erected for *Mytilus plicatus* Chemnitz and for several other species; but as *M. plicatus* Chemnitz 1785 (p. 153, Pl. 82, figs. 733 a and b) does not seem to be a mytilid, this genus is very questionable. Genus *Arcuatula* (Jousseaume) Lamy 1919, made for species with radiating sculpture *(Mytilus demissus* (Dillwyn) 1817), is considered to constitute a valid genus and is here treated as such. Genus *Fulgida* (Jousseaume) Lamy 1919, was established for *Perna fulgida* H. Adams (supposed to be synonymous with *Modiola lignea* Reeve by Lamy, with *Modiola philippinarum* Hanley by Iredale, 1939). Jousseaume wrote (cited by Lamy) that *Fulgida* was characterized by the glossy posterior and dorsal parts, while the ventral region, which usually is glossy and shining in *Modiolus,* is dull. This group may perhaps be used when the *Fulgida* of Jousseaume has been critically studied.

The west American species of *Modiolus* are partly of the typical form and partly with a straight hinge line having a more or less distinct dorsal angle. All are at present included in the genus *Modiolus s. s. Volsella salvadorica* Hertlein and Strong 1946 is not a *Modiolus* and is provisionally referred to the genus *Lioberus* Dall. One species is considered to be unnamed and is here described as *Modiolus neglectus* n. sp.

Young specimens are sometimes very difficult to refer to a particular species. The young specimens of *neglectus* and *eiseni* are rather easy to determine, while small *sacculifer, fornicatus, modiolus,* and sometimes *capax,* may be very difficult to separate. Small specimens with long smooth periostracum hairs may perhaps represent still another unrecognized species, but the material at hand is unfortunately too limited to allow a settlement of this problem. Carpenter (1855-57) says that very young specimens of *capax* have long smooth hairs which become relatively shorter and serrate. If this really is the case, young *capax* also can easily be confused with young specimens of other species. As there seems to be no safe way to name small specimens at present, they are not considered in this paper.

One specimen from Ecuador shows strong affinities to the Atlantic *Modiolus americanus* (Leach) and is listed tentatively under that name, together with specimens from Mazatlán and Bahía de la Magdalena found in the collections of the California Academy of Sciences.

Key to the west American species:

1. Periostracum with serrate hairs, left valve usually more inflated than the

right one, shell color often red in dried specimens, dorsal part of inside usually dark colored — *capax* (Conrad)

Periostracum with smooth hairs, usually equivalve — 2

2. Umbones inflated, twisted downward and outward, protruding beyond the anterior margin — *fornicatus* (Carpenter)

Umbones less inflated and twisted, never protruding beyond the anterior margin — 3

3. Anterior margin protruding for a considerable distance beyond the umbones, the anterodorsal margin with a narrow lunule and forming a sharp keel toward the umbones, dorsal margin straight — 4

Anterior margin only slightly protruding beyond the umbones, the lunule rather broad, anterodorsal margin not forming a sharp keel and dorsal margin curved — 6

4. Posterodorsal angle sharp (120°-140°), shell relatively short, the height measured perpendicularly to the hinge line distinctly more than half the length of the hinge line — 5

Posterodorsal angle rounded, shell more elongate, the height measured perpendicularly to the hinge line half the length of the hinge line — *rectus* (Conrad)

5. Shell triangular, posterodorsal angle about 120°-130°, posterodorsal part red — *eiseni* Strong and Hertlein

Shell rhomboidal, posterodorsal angle about 140°, posterodorsal part brownish-yellow — *neglectus* n. sp.

6. Anterior part typically pouting, forming a small but distinct narrow lobe, the margin bent considerably outward, shell thin, inside margaritaceous — *sacculifer* (Berry)

Anterior part more or less broadly rounded — 7

7. Shell rather solid without bright colors, periostracum thick with solid hairs, shell color typically reddish-violet *modiolus* (Linné)
Shell rather thin, often with color rays posteriorly, periostracum light brown, thin, with adherent sand grains and shell particles, finer and broader hairs *americanus* (Leach)

Modiolus capax (Conrad) 1837

Plate 6, fig. 30; text-figs. 50, 53 a-b, 54, 55

Modiola capax Conrad, Jour. Acad. Nat. Sci. Phila., vol. 7, 1837, p. 242.
Syn.: ?Modiola spatula Menke 1849.
Modiola subfuscata Clessin 1889.
Holotype: Academy of Natural Sciences, Philadelphia?
Type loc.: San Diego, California.
Remarks: This species, in spite of the variable form, is always easily recognized by the serrate hairs on the periostracum, and by the left valve, which is usually more inflated than the right one, the difference being

Fig. 47. *Modiolus modiolus* (Linné). The stippled anterior part indicates the lunule.
Fig. 48. *Modiolus modiolus* (Linné). Anterior part seen in an oblique view. Anterior retractor in the umbonal cavity behind the umbo. The tooth-like projection of the anterior margin behind the umbo is usually still more distinct.
Fig. 49. *Modiolus neglectus* n. sp. Long Beach, California. The interior with muscle scars.
Fig. 50. *Modiolus capax* (Conrad). Posterior part seen from behind.
Fig. 51. *Modiolus neglectus* n. sp. Long Beach, Calif. Posterior part seen from behind.
Fig. 52. *Modiolus modiolus* (Linné). Aleutian Islands. Posterior part seen from behind.
Fig. 53. a.b. *Modiolus capax* (Conrad). Puerto Refugio, Isla Angel de la Guarda, Gulf of California. Two different periostracum hairs from one specimen.
Fig. 54. *Modiolus capax* (Conrad). Sulphur Rock, Puerto San Bartolomé, Baja California. Periostracum hair.
Fig. 55. *Modiolus* sp. (perhaps *capax* Conrad). Santa Catalina Island, California. Periostracum hair of a peculiar type.
Fig. 56. *Modiolus americanus* (Leach). ½ mile SE of Punta Hughes, Bahía de Santa María. Periostracum hair.
Fig. 57 a.b. *Modiolus sacculifer* (Berry). San Miguel. Two types of periostracum hairs from one specimen.
Fig. 58. *Modiolus sacculifer* (Berry). S. of Pillar Point, Halfmoon Bay, California. Periostracum hair.
Fig. 59. *Modiolus neglectus* n.sp. Long Beach, California. Periostracum hair.


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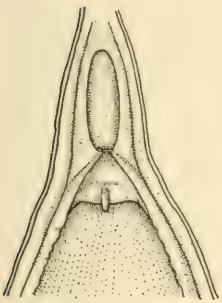
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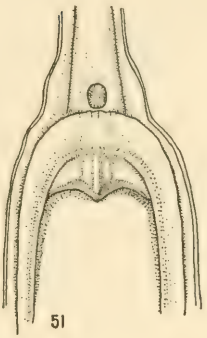
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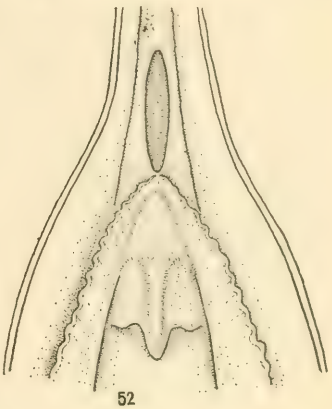
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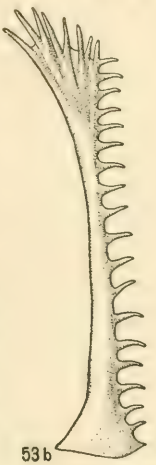
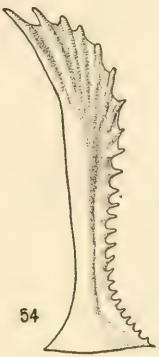
53a


53b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especially visible in the umbonal region. The hairy protuberances of the periostracum and the serrations on them are somewhat variable, from narrow to broader hairs with shorter or longer serrations on one side. Different types may be found on the same specimen. Carpenter (1855-57) says that very young specimens have long but not serrated hairs; usually serrated hairs are distinct even on specimens only 10 mm long. Two specimens with a length of 12 mm, one from Pt. Fermin, the other from Catalina Island, might be aberrant specimens of *M. capax,* as they have spade-shaped, but smooth, periostracum hairs.

The inside is generally reddish-violet on the posterior half. The dorsal mantle opening is rather large, elongate, usually with the rectum visible. The mantle edges of the branchial part are thin and the septum short, so the connection between the branchial and anal cavities is wide open.

Occurrence: Intertidal on rocks or boulders, often in mud down to 25 fms.

Distribution: Santa Cruz, California, to Payta, Peru; Galapagos Islands.

Modiolus fornicatus (Carpenter) 1865

Plate 6, fig. 26

Modiola fornicata Carpenter, Ann. and Mag. Nat. Hist., ser. 3, vol. 15, 1865, p. 178.

Holotype: In the collection of Mrs. Boyce, Utica, N. Y.

Type loc.: Santa Barbara, California.

Remarks: This species has been misinterpreted several times and the name *fornicata* has been used for specimens of *M. sacculifer* (Berry). *M. fornicatus* is easily recognized in typical specimens by the very inflated and curved oldest part of the shell, with the umbones protruding beyond the anterior margin. Smaller, less inflated specimens with less curved and protruding umbones, seem to be very like the young of other species of *Modiolus.* Good representative material of all sizes must be studied before *M. fornicatus* can be correctly described.

Large specimens between 11 mm and 35 mm have thick valves with a violet line inside, and a shining brown periostracum with remains of smooth hairs on the posterior part. The ligament is relatively short, the anterior part concealed between the umbo and the anterior margin; the anterior adductor is deepset, distant from the anteroventral margin; and the anterior retractor is fastened in the deep umbonal cavity.

Occurrence: Very little is known about the habitat of this species, as it has been confused with *M. sacculifer* (Berry).

Distribution: Trinidad, Humboldt County, California, to San Pedro and Cortez Bank, California.

Modiolus rectus (Conrad) 1837

Plate 7, figs. 33-35

Modiola recta Conrad, Jour. Acad. Nat. Sci. Phila., vol. 7, 1837, p. 243, Pl. 19, fig. 1.

Syn.: Mytilus (Modiola) flabellatus Gould 1850.

Holotype: Academy of Natural Sciences, Philadelphia.

Type loc.: Santa Barbara, California.

Remarks: This slender, elongate species is, in its typical form, easily known from other west coast *Modiolus;* but it has been confused with *M. neglectus,* which some authors have supposed to be the form or variety *M. flabellatus* (Gould). *M. rectus* is always more elongate and never shows the distinct posterodorsal angle of *M. neglectus.* The straight dorsal margin extends over to the posterior margin in a long arch without angulation. The color of the shell and the periostracum, and the posterodorsal hairs on the periostracum, are very like *M. neglectus.* The adductors are strong and so are the posterior byssal retractors, while the retractor of the foot and the anterior retractor are relatively weak. The posterior part of the mantle is very thick and shows a broad swollen branchial part.

Specimens collected by Mr. E. P. Chace at Alamitos Bay, Long Beach, California, May 4, 1954, were heavily infested with a parasite which formed a black, continuous body tapering from the posterior adductor toward the anterior end. This mass could be seen in the sides of the body and had penetrated into the gonads. It consisted of round hyaline elements, 0.1 mm in diameter, with a black central body. The nature of the parasite is not known.

There has been some discussion about *M. flabellatus* (Gould) 1950, described from Puget Sound. This form is much larger than the typical *rectus,* usually with the posteroventral part growing more rapidly than the rest of the shell, so that this part seems to be bent downward. Other specimens are more like the figure of the type in the report of the U. S. Exploring Expedition, reproduced by Oldroyd (1924, Pl. 6, fig. 2). These are all large specimens of *M. rectus,* as is easily seen when the growth lines of the older parts of the valves are studied. Such large specimens may be found wherever *M. rectus* lives and are not confined to a more limited area, though there seems to be some doubt whether small specimens really are found in the northernmost localities. The name *M. flabellatus* (Gould) is therefore a synonym of *M. rectus* and not a name for a special or northern form. Large specimens can reach a length of 23 cm.

Occurrence: Living burrowed in mud with the posterior margin above the surface, from the intertidal zone down to 25 fms. A "nest" of mud and sand particles seems to be built like that of *M. neglectus,* to prevent mud particles from entering the mantle cavity and to anchor the animal in the mud.

Distribution: Vancouver Island, British Columbia, to Outer Gorda Bank and Bahía Concepción (Boone, 1928), Baja California.

Modiolus eiseni Strong and Hertlein 1937

Plate 6, fig. 29

Modiolus eiseni Strong and Hertlein, Proc. Calif. Acad. Sci., vol. 22, 1937, pp. 160-161, Pl. 34, figs. 11, 14-16.

Holotype: California Academy of Sciences, no. 6968.

Type loc.: 38 miles SE of Mazatlán, Sinaloa, Mexico; 10-17 fms.

Remarks: This species might perhaps be *Modiola biradiata* Hanley 1843, but as the locality of Hanley's species is doubtful and the description seems to show minor differences, it is safest to use the name given by Strong and Hertlein. Eight small specimens of this typical species were found in the Hancock material, maximal length, 11.5 mm.

The lunule is dull and rather large and the white prodissoconch is elongate, oblique. The anterior adductor is narrow and follows the anterior margin. The posterior part of the mantle margins is thickened, the septum short, ending in a rounded knob, and the dorsal opening is elongate.

Occurrence: Recorded from 2 to 50 fms, or to 200 fms if the deepest haul mentioned by Strong and Hertlein is used. The bottom conditions are given as mud, sand, or shells. The Hancock material extends the distribution of this species from Mazatlán south to Panama.

Distribution: From off Outer Gorda Bank, Gulf of California, to off Bahía Honda, Panama.

Modiolus neglectus new species

Plate 7, figs. 31-32; text-figs. 49, 51, 59

Syn.: Volsella recta auct. non Conrad 1837.
Volsella flabellata auct. non Gould 1850.

Diagnosis: Shell elongate, inflated, with straight dorsal margin which reaches considerably before the umbo, sharply rounded from the anterodorsal angle; anterior margin sloping and evenly rounded to the nearly straight ventral margin. Posterodorsal angle rounded, posterior margin slightly convex and meeting the dorsal margin in an angle of about 140°,

which seems to be very constant. The anterodorsal margin raised and continuing to the close-set umbones; the upper dorsal part forming a lunule with dull periostracum. The shell bluish-white; the periostracum shining yellowish-brown, darkest and most shining in the median part of the shell, which often shows radial striations of darker and lighter color. On the rather prominent keel, the periostracum furnished with dense hairlike protuberances broad at the base, with a dorsal thicker part forming the hairs, which have a thinner membrane ventrally; the hairs less numerous toward the dorsal margin. The interior bluish-white; the anterior margin distinctly bent outward on the dorsal part and continuing slightly behind the umbo, ending in a small "tooth"; the ligament occupying three fourths of the posterior dorsal margin. The anterior adductor elongate and placed rather high up along the anterior margin; the posterior adductor round, with the continuous retractors starting above the adductor; the anterior retractor fastened in the umbonal cavity. The byssal cavity placed just behind the foot. The dorsal marginal opening small, the branchial part of the mantle margins thickened, the septum with a median flap.

Holotype: The Allan Hancock Foundation. Length, 88 mm; height, 37.5 mm; diameter, 33.5 mm.

Type loc.: San Diego, California.

Remarks: This apparently rather common species has been unrecognized for years, though the form is so typical and so different from *M. rectus,* that they can be separated at a glance. *M. neglectus* is much more inflated than *M. rectus;* the ratio of H/L, where L is the total or greatest length, is 35% to 40% in *M. neglectus,* while in *M. rectus* the same ratio is 25% to 30%.

Occurrence: M. neglectus seems to prefer deeper water than *M. rectus,* as the records are from 10 to 57 fms. It lives in sand or mud and spins a "nest" of small particles and fine byssus threads.

Distribution: Exact distribution unknown, but according to the material at hand it occurs from Monterey Bay, California, to Outer Gorda Bank, Baja California.

Modiolus sacculifer (Berry) 1953

Text-figs. 57 a-b, 58

Volsella sacculifer Berry, Trans. San Diego Soc. Nat. Hist., vol. 11, no. 16, 1953, pp. 407-409, Pl. 28, figs. 1-2.

Holotype: Stanford University, no. 7853.

Type loc.: San Pedro Harbor, California.

Remarks: The periostracum is hairy sometimes over most of the surface but always on the posterior part; the hairs are fine, often with a narrow lateral velum, and coarsest on the posterior side.

The anterior lunular part, so characteristic in most of the specimens, is not so well defined in small specimens, which often look very like small *M. modiolus.* The lunule is dull and usually distinctly set off from the rest of the shell. The inside is margaritaceous, white or reddish-white; the shell is thin compared to *M. capax* and *M. fornicatus.* The ligament is short, and the umbones nearly touch in the middle.

The anterior adductor is placed along the anterior part of the ventral margin, the posterior adductor is strong, with the retractors narrowly separated in two series, the anterior retractor strong. The posterior mantle margin is thick and protruding, the septum short with an inwardly bent median flap, and the dorsal opening large. The foot is strong, somewhat flattened; and the labial palpae are long.

Occurrence: Apparently a deeper water species living in "nests" of sand or hidden among holdfasts, etc.

Distribution: Hitherto recorded from Bechers Bay, California, south to San Clemente Island, California.

Modiolus modiolus (Linné) 1758

Text-figs. 47, 48, 52

Mytilus modiolus Linné, Systema Naturae, ed. 10, 1758, p. 706.

Holotype: ?

Type loc.: The Mediterranean.

Remarks: Typical specimens of this species, which is very common in the north Atlantic, are found in the northern parts of the Pacific. Smaller specimens have strong but smooth hairs on the periostracum, but these hairs are usually lost in older specimens. The anterior part is rounded and protrudes slightly beyond the umbones. The rather large lunule is dull and usually distinct in smaller specimens. The outline is rather variable and sometimes is much like some forms of *M. americanus* (Leach) or *M. capax* (Conrad). The posterior part of the mantle is much like that of *M. capax,* but the margins are more protruding and the septum longer, with a more pronounced median flap.

There has been much discussion about the distribution of *M. modiolus* on the west coast. Usually the southern limit is stated to be Laguna de San Ignacio, Baja California, but Burch, quoting Myra Keen, favors a southern limit at Monterey (see discussion in the Minutes of the Conchological Club of Southern California, no 36, June, 1944, p. 12). The rec-

ord from Laguna de San Ignacio may perhaps be founded on specimens of *Modiolus americanus* (Leach). Small specimens of *M. modiolus* are at present impossible to identify with certainty. There may be a possibility that the larvae of *M. modiolus* now and then settle far to the south of the usual habitat and live there for some time, but are unable to establish themselves. Perhaps some of the smooth-haired smaller specimens found south of Monterey are really young *M. modiolus*. It is to be hoped that some one will study this problem and make it possible to separate young specimens of the various species of *Modiolus*.

Occurrence: Living solitary, fastened to rocks, from a few fathoms down to at least 100 fms.

Distribution: Arctic Ocean to Monterey, California; Japan; Atlantic: south to Florida, and the Mediterranean.

Modiolus americanus (Leach) 1815

Plate 6, figs. 27-28; text-fig. 56

Modiola americana Leach, Zoological Miscellany, vol. 2, 1815, p. 32, Pl. 72, fig. 1.

Syn.: Modiola tulipa Lamarck 1819.

Holotype: British Museum?

Type loc.: ?

Remarks: One small specimen from Ecuador with a total length of 14.5 mm seems to be very close to this species. The shell is whitish but furnished with six or seven violet radiating striae starting just behind the white irregularly rounded prodissoconch. The anterior margin and the posterodorsal angle are broadly rounded. The periostracum is yellowish-white with fine hairs and adhering particles of shells and sand. The byssus is silklike, yellow.

Another specimen, from Bahía de Santa María, Baja California, with a total length of 29 mm, is brownish-yellow with a violet tinge on the umbones. This specimen is of the same form as the small specimen from Ecuador, but lacks the color rays. In the collections of the California Academy of Sciences, there are two samples of a *Modiolus* identical with the specimens from Bahía de Santa María. They are labelled Mazatlán, Sinaloa, Mexico, beach, no. 27223 (Hertlein collection), maximal length 38 mm, and Bahía de la Magdalena, Baja California, no. 20285 (Orcutt collection), maximal length 42 mm. These two samples are exactly like specimens from Clearwater Harbor, Florida, no. 5835.

Modiolus americanus (Leach) is closely related to the more northern *Modiolus modiolus* (Linné) but seems to differ in some respects. The shell

usually is thinner and the hairs on the periostracum seem to be broader and weaker than those found in *M. modiolus*. The posterior part of the mantle seems to be more like *M. capax* than *M. modiolus*. A comparison of the soft parts between *M. modiolus* and *M. americanus,* and between Pacific and Atlantic specimens, is necessary before the question about the allocation of west American specimens to *M. americanus* can be settled. These specimens are, as stated above, so like some samples of *M. americanus* from Florida that it seems impossible to give a description which can be used to separate the Pacific specimens.

Occurrence: The only depth record noted is 5 fms. in Bahía de Santa María.

Distribution: Bahía de la Magdalena, Baja California (perhaps Laguna de San Ignacio, Baja California, *M. modiolus* E. K. Jordan?) ; Mazatlán, Sinaloa, Mexico; Isla La Plata, Ecuador. In the Atlantic from North Carolina to the West Indies.

Genus **AMYGDALUM** Megerle von Mühlfeld 1811

Amygdalum Megerle von Mühlfeld, Gesell. Naturf. Freunde Berlin, vol. 5, 1811, p. 69.

Syn.: Modiella Monterosato 1884.

Type of genus: Amygdalum dendriticum Megerle von Mühlfeld 1811 = *Mytilus arborescens* Chemnitz 1795 (monotypic).

Remarks: The short generic diagnosis and the reference to Chemnitz, Pl. 198, figs. 2016 and 2017, clearly identify this genus. It is characterized by the thin modioliform shell, which is rather flat and furnished with a shining periostracum. The posterodorsal part is usually more or less spotted with white or gray, while the anteroventral side is uniform, sometimes blotched with yellow. Green colored species seem not to belong to this genus. The resilial ridge is very thin and apparently compact; the nymphae are weak.

The anterior adductor is elongate; the posterior adductor is small and round, placed high in the posterior part of the shell. The anterior retractor is slender and fastened in the umbonal cavity. The posterior retractors have a thin anterior branch and a more solid posterior branch fastened to the shell above the adductor. All retractors seem to go to the byssal gland (cfr. Pelseneer, 1911, pp. 17-18, Pl. 4, fig. 10; Pl. 5, fig. 1). The mantle margins are simple and a short septum separates the branchial part from the anal opening. The animal builds a nest of mud and sand particles held together by fine byssus threads.

This genus comprises species from deeper water apparently not closely related to *Modiolus,* perhaps closer to *Mytella.* As the species occur in all oceans and as the specific differences seem to be small, there has been a tendency to put all specimens in two species of world wide distribution. This seems not to be justified. There is a slight but distinct difference between the Atlantic *Amygdalum politum* (Verrill and Smith) in Verrill 1880 and the Pacific *Amygdalum pallidulum* (Dall) 1916 in the color and spots on the dorsal part. The Atlantic *Amygdalum dendriticum* Megerle von Mühlfeld 1811=*arborescens* (Chemnitz) 1795, is broader posteriorly like the broader Pacific species, and is furnished with markings of a pattern different from the narrower Pacific species *Amygdalum beddomei* Pettard and from species close to *A. beddomei* found on the west coast of America between Isla Gorgona, Colombia, and Payta, Peru. These specimens are here supposed to constitute an unrecognized species very close to but not identical with the Tasmanian *A. beddomei.*

Key to the west American species:

Shell much higher posteriorly than anteriorly; white lines parallel to dorsal margin and scattered white spots on a hyaline shell on the posterodorsal part	*pallidulum* (Dall)
Shell slightly higher posteriorly, grayish-brown triangular spots and irregular blotches on the posterodorsal part	*americanum n. sp.*

Amygdalum pallidulum (Dall) 1916

Plate 8, fig. 36; text-fig. 60

Modiolus pallidulus Dall, Proc. U. S. Natl. Mus., vol. 52, 1916, p. 404.
Holotype: U. S. National Museum. Cat. no. 212746.
Type loc.: Off San Luis Obispo Bay, California; 77 fms.
Remarks: The shell is elongate and rather narrow, with the nearly straight dorsal and ventral margins forming an angle of about 30°. The umbones are placed slightly behind the rounded anterior margin, which shows faint radiating lines on the lunular part. The posterior margins are evenly rounded. The anterior and central areas are opaque, grayish-white with yellow stains; the dorsal and posterior areas are translucent and furnished with white markings, which form longitudinal stripes dorsally and rhomboidal meshes, which sometimes become partly obsolete, on the central and posterior parts. The muscle scars are very indistinct on the thin shell, but the muscles are easily seen in specimens with the soft parts.

The largest specimen (1012-39) measures 21.5 mm in length, 11.9 mm in height, and 6.1 mm in diameter.

This species is very close to *Modiolus (Amygdalum) sagittatus* Rehder 1935; from off Florida, the only differences seem to be the narrower anterior part and the more convex ventral margin. Several specimens had small commensal crabs *(Pinnotheres)* in the mantle cavity.

Occurrence: A. pallidulum has a wide bathymetric range, as it is recorded taken alive by shore collecting and down to 210 fms. Usually the bottom consists of mud or fine sand, where the species lives in a "nest" made of fine byssal threads and mud particles. The Hancock material extends the distribution from Acapulco, Mexico, south to off the coast of Colombia.

Distribution: Off Bodega Head, California, to off the coast of Colombia, SW of Isla Gorgona (1°02′30″N, 81°12′W).

Amygdalum americanum new species

Plate 8, fig. 37

Diagnosis: The shell is thin but not translucent, elongate, with the umbones close to the anterior end. The posterior part is broader than the anterior, but the dorsal and ventral margins form only a small angle when continued forward. The prodissoconch is large, colorless or whitish, shining and distinctly set off from the rest of the shell. The anterior margin is rounded and slopes evenly to the ventral margin; the posterior margin is truncate, with rounded dorsal and ventral angles. The sculpture consists of fine concentric growth lines, more irregular ventrally; the periostracum is yellowish, the anterior and ventral parts being of a uniform yellowish-white color; in the upper part, fine hyaline lines run from the umbo backward, where they become obsolete; and some very fine brownish lines cross the growth lines toward the ventral margin in the anterior part. Grayish-brown triangular spots give a speckled appearance to the posterior and hinder dorsal parts of the shell. Some spots form irregular blotches along the dorsal margin, or bandlike figures toward the ventral margin. These rather variable color spots are not seen in small specimens, but in them the hyaline lines are very distinct. The interior is white and margaritaceous, with fine radiating striations; the muscle scars are indistinct, but the muscles are placed the same way as in *A. pallidulum*. The posterior adductor is slightly larger, and the anterior adductor is closer to the umbones. The foot is placed in the anterior third of the shell, the byssal gland small. The mantle margins are thickened in the posterior branchial part and they and the septum are speckled with

small brownish spots. The anal opening has folded margins which seem to form a short siphon. The gonads are dorsal.

Holotype: Allan Hancock Foundation. Length, 21 mm; height, 10 mm; diameter, 6 mm.

Type loc.: 409-35, Isla Gorgona, Colombia; 20 fms.

Remarks: This species is very close to *Amygdalum beddomei* Pettard (Iredale, 1924, p. 197, Pl. 35, fig. 21). The posterior margin, however, is more truncate in *Amygdalum americanum* and does not show the long, rounded posterodorsal curve which seems to be typical in *A. beddomei.* The darker markings are also different, according to Iredale's figure. Lamy (1936) records *Modiolus (Amygdalum) arborescens* (Chemnitz) from Payta, Peru; but it seems reasonable that Lamy had specimens of *Amygdalum americanum,* as there is no other record of *Modiolus arborescens* from the Pacific coasts of America. Two examples of this species from Bahía de Manzanilla are preserved in the San Diego Museum of Natural History.

Occurrence: This species seems to prefer shallower water than does *Amygdalum pallidulum,* as it is taken alive between 2 and 20 fms, on muddy or sandy bottom. There were no traces of a nest like that of *A. pallidulum,* but a nest is easily lost during the sifting of the material.

Distribution: Recorded from Bahía Tenacatita, Mexico, south to Isla Gorgona, Colombia, or Payta, Peru (Lamy).

Genus **LIOBERUS** Dall 1898

Lioberus Dall, Trans. Wagner Free Inst. Sci., vol. 3, part 4, 1898, p. 805.

Type of genus: Modiola castanea Say 1822 (orig.).

Remarks: Dall's diagnosis is short. As a group (section or subgenus) of *Modiolaria* Beck, the following diagnosis is given: "Shell with the radial sculpture obsolete or absent; branchial siphon equal or nearly equal to the anal, both much elongated."

Though the form and smooth surface give the shells a superficial resemblance to *Modiolus,* the long siphons show that the group has other affinities. It seems safest to treat the group as a separate genus until more is known of the relationship to the genus *Musculus* Röding.

Lioberus castaneus (Say) seems to be at least superficially like some other species usually referred to *Modiolus, e. g., Modiolus elongatus* (Swainson) (cfr. Pelseneer, 1911, p. 18, Pl. 4, fig. 8; Pl. 5, fig. 12), which perhaps may be found to belong to *Lioberus. Volsella salvadorica* Hertlein and Strong is at least tentatively referred to *Lioberus* because of the anatomy.

Lioberus salvadoricus (Hertlein and Strong) 1946

Plate 8, fig. 38; text-figs. 61-62

Volsella (Volsella) salvadorica Hertlein and Strong, Zoologica, vol. 31, part 2, 1946, p. 73, Pl. 1, figs. 7 and 11.

Holotype: California Academy of Sciences. Paleo. type collection.

Type loc.: Off La Libertad, El Salvador; 25 m.

Remarks: One small (9 mm) dried specimen allowed a superficial inspection of the anatomy after it had been soaked in hydroxide for several hours. The most significant result was the observance of the long siphons, of which the branchial, with a ventral opening, has the same length as the anal siphon. The anterior retractor was placed well before the umbo; the posterior retractors and the adductor were elongate and placed in a curve in the anteroventral angle.

The shell shows distinctly raised concentric lines on the anterior part, which are also visible on the inside. This sculpture is not mentioned in the original description but is visible on the figure of the type. The posterior part is covered by a filthy mass of mud particles held together by fine threads. There seem to be no hairs on the periostracum, so this covering may be the remnants of a nest. The anterior margin is distinctly grooved.

Occurrence: Dredged from 2 to 16 fms. The bottom consisted of mud, sand, and shells.

Distribution: From Bahía Cocos, Boca de Culebra, Costa Rica, north to off La Libertad, Salvador.

Genus **MUSCULUS** Röding 1798

Text-fig. 63

Musculus Röding, Museum Boltenianum, Part II, 1798, p. 156.

Syn.: Modiolaria Beck in Robert 1838, 1840.

Type of genus: Mytilus discors Linné 1767 (subsequent designation by Iredale 1915).

Remarks: This genus is characterized by the anterior adductor being placed before the umbones and the posterior retractors being continuous and united with the posterior adductor. The extensile posterior part of the mantle forms a long anal siphon, with the lower branchial opening nearly of the same length. For the anatomy, see Pelseneer, 1911, pp. 19-20, Pl. 5, fig. 5.

The shell is typically radially sculptured in the anterior and posterior part, without radiating sculpture in the middle. The valves are rather flat, without a distinct keel, but the posterodorsal part is separated from the rest of the valve by a more or less pronounced furrow.

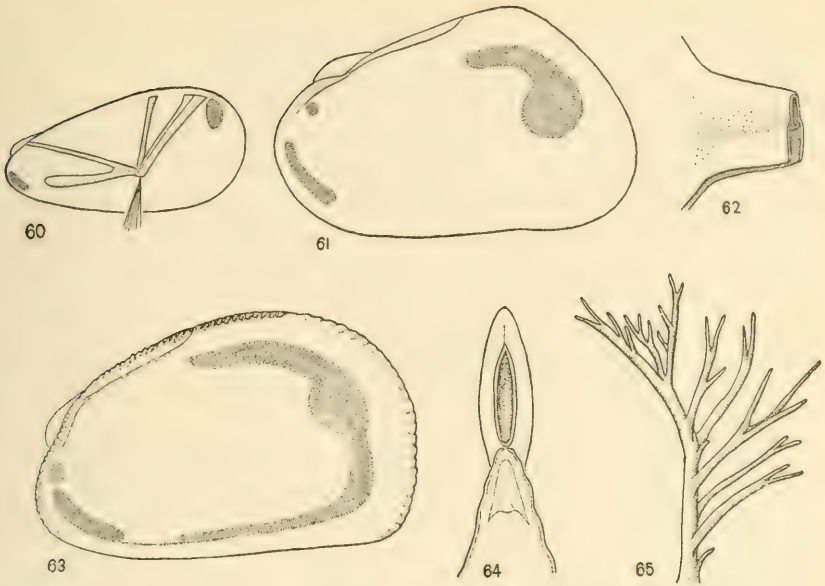


Fig. 60. *Amygdalum pallidulum* (Dall). Santa Cruz Island, California. Adductor and retractor muscles.

Fig. 61. *Lioberus salvadoricus* (Hertlein and Strong). Bahía Cocos, Costa Rica. Note the place of the anterior retractor distinctly before the umbo.

Fig. 62. *Lioberus salvadoricus* (Hertlein and Strong). Bahía Cocos, Costa Rica. The siphons, showing that the branchial siphon, not closed ventrally, is of the same length as the anal siphon.

Fig. 63. *Musculus discors* (Linné). Ireland. Arrangement of muscle scars.

Fig. 64. *Gregariella coarctata* (Carpenter). Laguna de Scammon, Baja California. Posterior part seen from behind.

Fig 65. *Gregariella chenui* (Recluz). Seal Beach, California. A branched periostracum hair.

Species with a quite different anatomy have, because of the form and sculpture, been placed in the genus *Musculus*. These species, *e. g., M. marmoratus* (Forbes), *M. impactus* (Hermann), *M. cumingianus* (Reeve), *M. lebourae* White, are more inflated than the typical *Musculus,* and the arrangement of the retractor muscles is quite different. (For the anatomy of *M. marmoratus,* see List, 1902, Pl. 20, figs. 4-5; and for that of *M. lebourae,* see White, 1949, p. 47.) The anterior retractor is like *Musculus,* but the posterior retractors have a strong, elongated branch fastened along the dorsal margin and a single slender branch fastened above the posterior adductor.

At least two of these species live in a test of Ascidia *(M. marmoratus* and *M. lebourae)*. These species certainly should be removed from the genus *Musculus* and placed in a separate genus. Swainson, 1840, p. 385, described *Lanistes* (as of Humphreys) with one species, *Mytilus discors* (Enc. Méth. 204, f. 5), which is *Musculus impactus* (Hermann) 1782. Unfortunately *Lanistes* is preoccupied by Montfort 1810. Gray, 1847, gave a new name *Lanistina* to replace *Lanistes* Swainson, and this name seems to be valid for the species of the *Musculus impactus* type. But Gray in 1843 had used the genus *Modiolarca* for *impacta* and if this is not a misprint for *Modiolaria,* it antedates *Lanistina* by four years. Until this question is solved, it seems best to use *Lanistina* Gray 1847. Whether species belonging to *Lanistina* occur on the west coast of America is not proved, as the record of *Musculus marmoratus* (Forbes) from Puget Sound seems doubtful.

Many species and varieties of *Musculus* are recorded and described from the Arctic Seas, the Bering Sea, or to the north of California, but two species only are found along the coasts of California. Both seem to be rare. *M. senhousei* (Benson) is introduced.

Key to the west American species:

1. Shell thin, green colored with faint radiating striae posteriorly — *senhousei* (Benson)
   Shell more solid, olive to blackish with distinct posterior striae — 2
2. Sculpture on the median part of the shell irregularly concentric, color olivaceous with silky lustre — *olivaceus* Dall
   Median part of the shell smooth, blackish — *protractus* Dall

Musculus senhousei (Benson) 1842

Modiola senhousia Benson, Ann. and Mag. Nat. Hist., vol. 9, 1842, p. 489.

Syn.: Modiola senhausii Reeve 1857.
Modiolus senhousei Lamy 1936.
Brachyodontes senhausi Jukes-Browne 1905.

Holotype: British Museum.

Type loc.: Chusan, China.

Remarks: This species, generally considered to be a *Modiolus,* has the characters typical of the genus *Musculus, e. g.,* the anterior retractors

before the umbones; radiating striations on the anterior part; the lunule with crenulated margin; faint but distinctly visible radiating striae on the posterior part; and crenulations along and behind the ligament.
Occurrence: According to Allyn G. Smith (1944), this species is found in the San Francisco Bay area. It was later collected by Dr. G. D. Hanna at Coyote Point, San Francisco Bay, California, March 12, 1949, according to samples in the collection of Dr. Howard H. Hill. Apparently *M. senhousei* has been introduced into San Francisco Bay with shipments of Japanese oysters.
Distribution: San Francisco Bay (introduced); Japan, China.

Musculus olivaceus Dall 1916

Plate 8, fig. 39

Musculus olivaceus Dall, Proc. U. S. Natl. Mus., vol. 52, 1916, p. 405.
Holotype: U. S. National Museum. Cat. no. 210790.
Type loc.: Off Bering Island; 10 fms.
Remarks: This species has ten or eleven anterior radial ribs which gradually become weaker; and many posterior ribs which are not bordered in front by a furrow, but increase in strength backward until the ribs are slightly broader than the interspaces. The fine concentric threads cross the interspaces and give the median part an irregular concentric sculpture. The margins are crenulated according to the sculpture; and below the umbo are four strong toothlike crenulations. The ligament is short, the prodissoconch is whitish and unsculptured, and the periostracum is olivaceous with a silky lustre. Maximal length, 11 mm.
Occurrence: Occurring in moderate depths, nature of bottom and if nest-building unknown.
Distribution: Bering Sea to Catalina Island, California.

Musculus protractus Dall 1916

Musculus niger protractus Dall, Proc. U. S. Natl. Mus., vol. 52, 1916, p. 405.
Holotype: U. S. National Museum. Cat. no. 222017.
Type loc.: North of Nunivak Island, Bering Sea; 9 fms.
Remarks: This species, which originaly was described as a variety of *M. niger* Gray but is considered a separate species by Oldroyd (1924) and Keen (1937), is more inflated and elongate than young specimens of *M. niger*. The median area is described as being smooth and blackish.

Length, 13 mm. There are no specimens in the Hancock collections.
Occurrence: Moderate depths, the bottom in the type locality consisting of gravel.
Distribution: Nunivak Island to Monterey, California.

Genus **GREGARIELLA** Monterosato 1884

Gregariella Monterosato, Nomenclatura Generica e Specifica de alcune Conchiglie Mediterranee, 1884, p. 11.
Syn.: Botulina Dall 1889.
Trichomusculus Iredale 1924.
Tibialectus Iredale 1939.
Type of genus: Modiolus sulcatus Risso 1826 *(non* Lamarck 1805, 1819) = *Modiolus barbatellus* Cantraine 1835 = *Modiola opifex* Say 1825 (subsequent designation by Crosse 1885).
Remarks: There seems to be no difference between *Botulina* Dall, *Trichomusculus* Iredale, *Tibialectus* Iredale, and *Gregariella,* and the first three mentioned genera are considered to be synonyms. The original diagnosis in Italian says that one third of the valve is smooth, two thirds decussate, the periostracum hairy; the hinge with rudimentary oblique teeth, and the dorsal margin crenulated. The sculpture of *Gregariella* is slightly unlike that of *Musculus,* as the first posterior radiating striae are not continued to the ventral margin but stop gradually on the middle part. The mantle margin is smooth, the posterior part forming a branchial siphon open ventrally and an elongate anal siphon. The anterior retractor is before the umbo.

Dall (1889) introduced the name *Botulina* as a section of *Modiola,* without a description, and gave *Modiola opifex* Say as the only species. (Say described this species in 1825 from specimens found embedded in sand on the valve of a *Pecten,* which he named *nodosus* Linné, though he said that the shells, which were presented to the Academy of Natural Sciences in Philadelphia by the U. S. Navy, came from the Island of Minorca. One should suppose that the reference to this locality is more reliable than a species name, and the *P. nodosus* of Say might be a *Pecten maximus* Linné.) *Modiola opifex* Say is also mentioned by Hanley (1842-56, p. 239) as from Minorca. Philippi (1847) gave a new description of *?Modiola opifex* Say, with a good figure, from a specimen obtained in Brazil by Kröyer. Philippi was not sure that his species with long, branched hairs on the posterior keel was the same as Say's, because Say did not mention this distinct and characteristic periostracum. The specific name *opifex* Say has nevertheless been used since for the east

American shell described by Philippi (not *Modiola opifex* (Say) Verrill and Bush, 1900, which is *Modiola divaricata* (Philippi)). If the locality for *M. opifex* is correct, and it must be, this name should be used for the Mediterranean species, with *Modiolus sulcatus* Risso 1826 *(non* Lamarck 1805), *Modiolus barbatellus* Cantraine 1835, *Modiola petagnae* Scacchi 1836, and *Modiola costulata* Philippi 1836 as synonyms. The Mediterranean species has the same branched hairs on the periostracum as described by Philippi for his *Modiola opifex* but, until they are proved conspecific, the oldest name, apparently *Mytilus chenui* Recluz 1842, must be used for the east American species.

The common west American species has been named *Modiola opifex* Say or *Modiolaria denticulata* Dall 1871. What *M. denticulata* Dall really is, is difficult to tell. After a careful study of the description and comparison with specimens of the common west coast *Gregariella,* there seems no other solution than to consider *Modiolaria denticulata* Dall another larger, differently formed species of *Gregariella;* but only a study of the type can solve the question. Whether the west American species is conspecific with the Atlantic one has not been proved, but they are at least closely related to each other. Therefore *chenui* Recluz 1842 is used as the specific name. The other more southern species, *Crenella coarctata* Carpenter, is likewise very close to *Modiola divaricata* Philippi=*Mytilus coralliophagus* (Gmelin), from the Atlantic.

The west American species of *Gregariella,* except *denticulata,* are easily separable.

Key to the west American species:

Sculpture forking along the distinct keel, hairs on periostracum smooth	*coarctata* (Carpenter)
Sculpture consisting of radial lines crossed by incremental lines, keel weak, hairs on periostracum branched	*chenui* (Recluz)

Gregariella coarctata (Carpenter) 1856

Plate 9, fig. 48; text-fig. 64

Crenella coarctata Carpenter, Catalogue of the Reigen Collection of Mazatlan Mollusca, 1856, pp. 123-124.

Holotype: British Museum.

Type loc.: Mazatlán, Mexico (here designated).

Remarks: Carpenter's description leaves no doubt about this species, which is credited to Dunker in the literature. It is very close to *Modiola divaricata* Philippi 1847 from the West Indies, which is supposed to be

identical with *Mytilus coralliophagus* Gmelin, based on Pl. 84, fig. 752, of Chemnitz. The radial sculpture on the posterior part is divaricating along the keel, the anterior radial sculpture is very distinct, the umbones anterior, and the hairs on the periostracum on the keel are fine and dense without branches.

Occurrence: Carpenter says that this species is found burrowing in the shells of *Spondylus calcifer* and *Murex regius*. Depth records are from 2 to 9 fms. The Hancock material extends the distribution considerably.

Distribution: Laguna de Scammon, Baja California, to Isla Taboga, Panama; the Galapagos Islands.

Gregariella chenui (Recluz) 1842

Plate 8, fig. 40; text-fig. 65

Mytilus chenui Recluz, Revue Zool., vol. 5, 1842, p. 306.

Syn.: Modiola opifex auct. non Say 1825.

Botulina denticulata auct. non Dall 1871.

Holotype: ?

Type loc.: Brazil.

Remarks: Shell white, small, with the umbones anteriorly placed, of a broadly oval form with sloping curved anterior and posterior margins, broadest in the posterior half. Periostracum yellowish with long branched hairs on the posterior part. Sculpture consisting of a few radial anterior striae, a median part without radial sculpture, and distinct radial striae on the posterior part, the first not reaching to the ventral margin, the dorsal ones bent backward. The radiating striae crossed by distinct but somewhat irregular concentric lines, giving the posterior part a decussated sculpture. The anterior dorsal margin somewhat thickened and crenulated; the posterior dorsal margin with strong crenulations which become smaller on the posterior margin and hinder part of the ventral margin; the middle part of the ventral margin smooth. The ligament internal and descending backward, supported by a distinct nymphae.

As stated earlier, the west American species seems to be identical with the east American one described and figured by Philippi (1847) as *?Modiola opifex* Say. There might be some uncertainty as to the oldest name for this species. If *Modiola opifex* Say, or the Mediterranean species, should turn out to be the same as the species from Brazil, which is very improbable as the sculpture is different, then *M. opifex* Say could be used for the west American species too. Until they are proved conspecific, the name *chenui* Recluz seems to be the oldest one available.

Occurrence: The Hancock collections contain many samples of dead

specimens, while only a few seem to have been taken alive, in depths ranging from 16 to 50 fms. Including the valves, of which many are fresh, with the periostracum, the distribution is extended very far south in comparison to what was hitherto known.

Distribution: Monterey, California, south to Bahía de la Independencia, Peru.

Gregariella denticulata (Dall) 1871

Modiolaria denticulata Dall, Amer. Jour. Conch., vol. 7, 1871, p. 154.

Holotype: U. S. National Museum.

Type loc.: Acapulco, Mexico.

Remarks: As discussed previously, this species is at present impossible to interpret and is listed here in the hope that future students may be able to solve the puzzle. Dr. Rehder has kindly informed me that the type is a *Gregariella.* It might therefore be a synonym of *Gregariella chenui* (Recluz).

Distribution: Acapulco, Mexico.

Genus CRENELLA Brown 1827

Text-fig. 69

Crenella Brown, Illustrations of the Conchology of Great Britain and Ireland, 1827, Pl. 31, figs. 12-14.

Syn.: Stalagmium Conrad 1833.

Myoparo Lea 1833.

Nuculocardia Orbigny 1845.

Type of genus: Mytilus decussatus Montagu 1808 (monotypy).

Remarks: This genus comprises small inflated species with radiating sculpture, a thickened and striated hinge, a sunken ligament, and a finely striated and thickened dorsal margin. Otherwise the margins are crenulated corresponding to the sculpture. The foot (text-fig. 69) is long, slender, with a thick apex. The posterior retractor muscles are relatively strong and fastened to the valves in connection with the posterior adductor. The anterior retractor could not be observed and must be very weak.

The sculpture of typical species of *Crenella* can be separated into three areas: the anterior and the posterior areas have more or less unilateral bifurcation, the middle area has undivided or bifurcate sculpture.

There seem to be only two species on the west coast of America, both extremely variable in outline and in the characters of the hinge, which change during the growth of the specimens (Bernard, 1898). The northern species, which has been named *Crenella decussata* (Montagu), is

probably the northern west coast species, and the more southern species can, as far as I am able to decide, not be separated from the Caribbean species described by Orbigny as *Nuculocardia divaricata.* In the area where these two species overlap in their distribution, the southern species seems to be much more like the northern and not typical. The separation of these species is therefore sometimes very difficult without large series for comparison, and a thorough revision is highly needed for *Crenella,* as for so many other mytilid genera.

Key to the west American species:

Sculpture fine, with narrow interspaces, narower than the ribs, which on the central part bifurcates in an arrowlike manner; inflated, elongate when full-grown, hinge strong, color white	*divaricata* (Orbigny)
Sculpture coarse with interspaces as wide as or wider than the ribs, less inflated, more rounded form even when full-grown; hinge weaker; color more grayish-yellow	*decussata* (Montagu)

Crenella divaricata (Orbigny) 1853

Plate 8, figs. 42, 44

Nuculocardia divaricata Orbigny, Hist. Phys., Pol. et Nat. de l'ile de Cuba. Mollusques, vol. 2, 1853, p. 311, Pl. 27, figs. 56-59.

Syn.: Crenella inflata Carpenter 1864.

Crenella ecuadoriana Pilsbry and Olsson 1941.

Holotype: ?

Type loc.: Cuba.

Remarks: Specimens from the Caribbean are impossible to separate from specimens from off Central America, which therefore must be considered to belong to the same species. *Crenella inflata* Carpenter 1864 seems to be based on specimens of *C. divaricata* (Orbigny) with a strong hinge; and *Crenella ecuadoriana* Pilsbry and Olsson 1941 represents, as far as I can decide, an elongate specimen of *C. divaricata* (Orbigny). One character, which usually is easily seen and which separates *C. divaricata* from *C. decussata,* is the peculiar way the ribs on the central part of the disc branch, one set within the other, with the points toward the umbones.

Valves which must be referred to *C. divaricata* are found along the coasts of Baja California north to San Miguel Island, California, sometimes together with valves of *C. decussata.* I am unable to decide whether *C. divaricata* lives so far to the north, as the few living specimens in the material are all *C. decussata.*

Occurrence: Valves have been obtained in depths ranging from 2 to 250 fms. As no living specimens are preserved in the Hancock material, the depth ranges of this species cannot be stated.
Distribution: Records of valves are from Callao, Peru, north to San Miguel Island, California, including the Gulf of California.

Crenella decussata (Montagu) 1808

Plate 8, figs. 43, 45

Mytilus decussatus Montagu, Testacea Britannica, Suppl., 1808, p. 69.
Holotype: British Museum.
Type loc.: Scottish coast.
Remarks: Whether the Pacific specimens really belong to the Atlantic *C. decussata* (Montagu) is very difficult to decide. Specimens from northern Norway seem to be more coarsely sculptured and to have a still weaker hinge than specimens from the California coast. The name *decussata* has been in use for Pacific specimens for many years, and they certainly are very closely related to the Atlantic species.
Occurrence: Living specimens are recorded in depths from 5 to 144 fms, from a bottom of sand or mud.
Distribution: Valves are found from Canal de Dewey, Baja California, northwards, while living specimens are recorded from San Clemente Island, California, north to Alaska.

Genus **SOLAMEN** Iredale 1924

Solamen Iredale, Proc. Linn. Soc. New South Wales, vol. 49, 1924, p. 198.
Type of genus: Solamen rex Iredale 1924 (monotypic).
Remarks: In the diagnosis, Iredale says that the anterior margin is lower and more sinuate than the posterior, but his figures of *S. rex* (Pl. 33, fig. 15; Pl. 35, fig. 2) seem to show the opposite condition. *Arcoperna recens* Tate 1896 is very close to *S. rex*.

The common and well known species *Crenella columbiana* Dall 1897 seems to have its place in the genus *Solamen,* though the young specimens have distinctly thickened and crenulated margins below the umbones. *Crenella megas* Dall 1902 seems to have been based on an extremely large specimen of *C. columbiana,* even though the type locality of *C. megas* is much farther south than *C. columbiana* is reported to occur. *Crenella rotundata* Dall 1916 is perhaps founded on a young specimen of *C. columbiana,* but a careful study of the types is needed before *C. megas* and *C. rotundata* can be considered synonyms of *C. columbiana* with certainty.

The genus *Solamen,* which perhaps will be shown to be a subgenus of *Crenella* Brown, comprises two Australian species, one species from Java *(Solamen sibogae* Prashad 1932), and three Japanese species; and perhaps a few other species of *Crenella* should be referred to this genus.

Solamen columbianum (Dall) 1897

Plate 8, fig. 46; text-figs. 66-68

Crenella columbiana Dall, Bul. Nat. Hist. Soc. British Columbia, vol. 2, 1897, p. 4, Pl. 1, figs. 3 and 5.

Syn.: ?Crenella megas Dall 1902.

?Crenella rotundata Dall 1916.

Holotype: U. S. National Museum. Cat. no. 107630.

Type loc.: Chernoffski, Unalaska; 109 fms.

Remarks: This species and perhaps also the type of the genus, *S. rex* Iredale, have fine radiating striae separated into three areas, as in *Crenella,* by slight differences in the sculpture. The anterior part is separated from the main part of the shell by a smooth narrow stripe; the radiating striae anterior to this smooth stripe fork out from it. There is also an irregular, partly smooth stripe on the posterior part, with lateral forking of the striae anterior to it. The radiating striae on the median part do not fork, but have some striae in the interspaces in the younger parts of the shell.

The short ligament is not situated in an inwardly sloping groove, but placed on thin nymphae with a resilial ridge. Margins are most conspicuously crenulated in the anterior part, with no thickening below the umbo. There are tooth like crenulations in larger specimens. Specimens with a length of 6 mm have the same vertically thickened, striated subumbonal part found in species of *Crenella,* and can be separated from them only by the finer striae and thinner shell. The form is round in small specimens, with a shining white prodissoconch. As the animals grow, they become more elongate and the posterior part is attenuated *(megas* Dall). One large specimen measures 21.5 mm in length, 15 mm in height, and 14.2 mm in diameter, and the largest specimen (broken) has a length of at least 22 mm. Dall says the extreme length is 16 mm.

The figure of a 15 mm specimen (Dall, 1897) is not much like the figure (Dall, 1925, Pl. 9, fig. 1) of a young shell, which seems to have broader ribs with linear interspaces. Young shells, however, look rather different from larger ones, for the white color and less inflated form make the ribs look broader. But as the large, white, smooth prodissoconch is the same size, it seems reasonable to consider them all the same species.

The shells usually have mud and sand particles adhering to the surface, and on both sides of the umbones there is a ferruginous coating. The anatomy of this species is most interesting and unlike that of other mytilids. The anterior adductor is very narrow and elongate and placed along the extreme border of the anteroventral angle. The posterior adductor is seen as a round dark spot in the posterodorsal part, a little inside the shell margin. The foot is strong, cylindrical, with a swollen apex furrowed on the posteroventral side and showing a median constriction. There seems to be no open furrow on the posterior part of the foot proper and no traces of a byssus or a byssal gland. Two short anterior retractors are fastened to the valves in the umbonal cavity, and thin muscle threads extend backward to the posterior adductor and are fastened to the shell or the adductor on the sides. There are no muscles for the byssus, and the foot retractors are astonishingly weak. The form of the foot indicates that the animal moves in the mud by anchoring the foot and inflating the apex like a balloon; then the animal is pulled forward by the weak muscles. The mantle margins are united in the anterior half of the ventral side. The ventral opening is short and is closed posteriorly by the septum, which is striated longitudinally. Just before the septum opens to a relatively large anal opening, the margins are furnished with a row of small papillae. The gonads are placed on the dorsal side.

Occurrence: This species is found in depths varying from 16 to 290 fms. The bottom usually consists of mud of various types or of sand; also gravel is reported from a few localities.

Distribution: The distribution has been given as from the Aleutian Islands to San Diego, California. The southern limit is now moved to Isla Clarión, Mexico. It is also found in the Gulf of California. If we include *megas* Dall, the southern limit is the Bahía de Panamá.

Genus **BOTULA** Mörch 1853

Botula Mörch, Catalogus Conchyliorum quae reliquit D. Alphonso d'Aguirra & Gadea, comes de Yoldi. Fasc. secundus. Acephala, 1853, p. 55.

Type of genus: Mytilus fuscus Gmelin 1791 (Subsequent designation by Dall, Bartsch, and Rehder 1938).

Remarks: This genus is rather different from all other groups studied, as the anterior retractor is placed on the margin of the shell just below the umbones. The posterior adductor is small and the posterior retractor

leaves a small scar above the adductor. There are traces of siphonal retractor muscles in the middle of the valve and the siphons are long, even the branchial one, with the septum ending below the branchial siphon in three branched flaps.

The umbones are incurved; the margin above the ligament and just behind it is finely, transversely striated.

Fig. 66. *Solamen columbianum* (Dall). Off Pyramid Cove, San Clemente Island, California. Placement of adductor muscles.

Fig. 67. *Solamen columbianum* (Dall). Off Santa Rosa Island, California. The strong cylindrical foot with apical inflated part, relatively strong anterior retractors and very weak posterior retractors.

Fig. 68. *Solamen columbianum* (Dall). Off Santa Rosa Island, California. Posterior part seen from behind. Fine papillae on the upper part of the mantle margin which terminates in a heartshaped flap below the anal opening.

Fig. 69. *Crenella decussata* (Montagu). El Segundo, California. Foot with posterior retractor and adductor.

Fig. 70. *Botula fusca* (Gmelin). 4 miles N. of Isla Tortuga, Venezuela. Muscle scars. Anterior and posterior adductors are rather large, anterior retractor placed on the anterior margin beyond the umbo, posterior retractor very small and placed above the adductor. Indistinct scars in the middle are formed by the retractors of the siphons.

Fig. 71. *Botula fusca* (Gmelin). 4 miles N. of Isla Tortuga, Venezuela. The separated anal and branchial siphons are of nearly equal length.

Fig. 72. *Botula fusca* (Gmelin). 4 miles N. of Isla Tortuga, Venezuela. Branchial siphon in posteroventral view showing the three branched flaps on the septum.

Fig. 73. *Adula californiensis* (Philippi). Cape Arago, Coos County, California. Muscle scars with the scars for the siphon retractors below the posterior adductor.

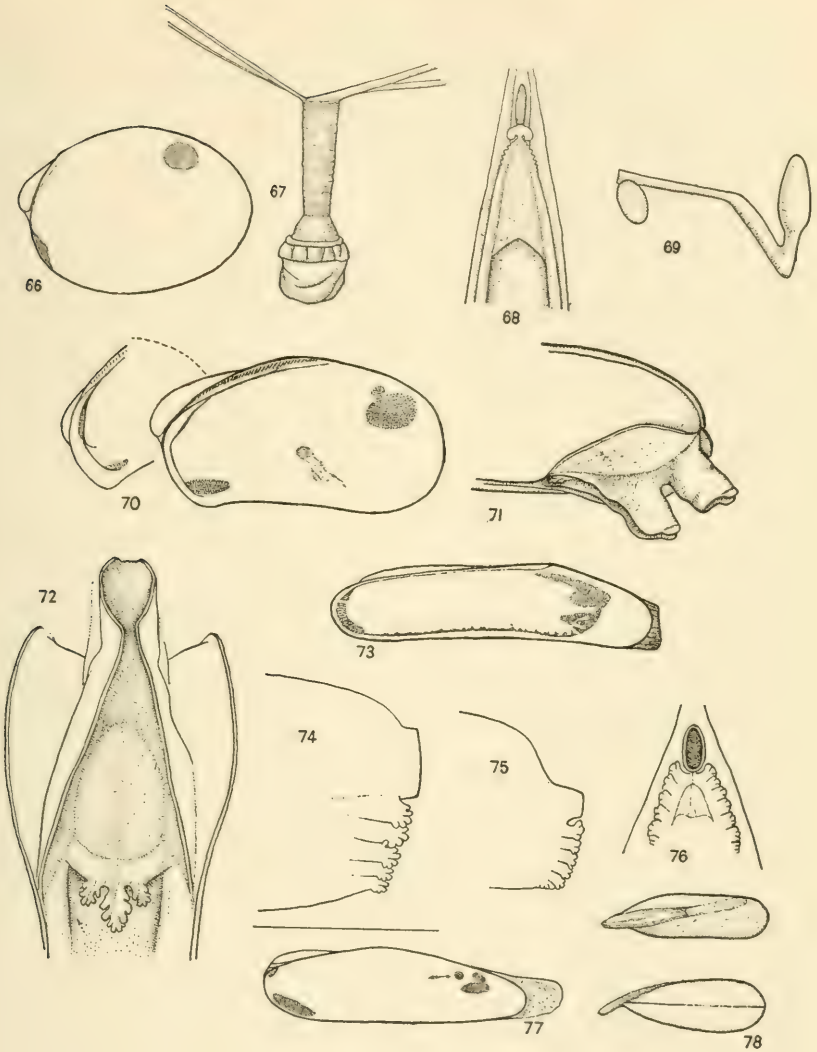
Fig. 74. *Adula californiensis* (Philippi). Cape Arago, Coos County, California. Posterior part of the mantle with the anal siphon and the papillae on the branchial part.

Fig. 75. *Adula diegensis* (Dall). Bodega Lagoon, Sonoma County, California. Posterior part of the mantle with the anal siphon and the papillae on the branchial part.

Fig. 76. *Adula diegensis* (Dall). Bodega Lagoon, Sonoma County, California. Posterior part seen from behind.

Fig. 77. *Lithophaga* (*Labis*) *attenuata* (Deshayes). Puerto San Bartolomé, Baja California. Placement of muscle scars.

Fig. 78. *Lithophaga* (*Diberus*) *canalifera* (Hanley). Bahía de Manta, Ecuador. a. Side view with the projecting incrustation. b. Dorsal view of the specimen with the incrustation on the left valve.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Botula fusca (Gmelin) 1791

Pl. 9, fig. 52; text figs. 70-72

Mytilus fuscus Gmelin, Systema Naturae, ed. 12, 1791, p. 3359.
Syn.: Mytilus cinnamominus Chemnitz 1785.
Modiola cinnamomea auct. non Lamarck 1819.
Holotype: ?
Type loc.: ?
Remarks: This species, which has been given the name of the West Indian species, was reported by Carpenter (1856) from Mazatlán as *Lithophagus cinnamomeus* (Chemnitz) and by Strong and Hanna (1930) from Las Tres Marías as *Botula cinnamomeus* (Chemnitz). As far as is known, these are the only records of *Botula* from the west coast of America.
Distribution: Mexico. Atlantic: North Carolina to the West Indies.

Genus **DACRYDIUM** Torell 1859

Dacrydium Torell, Bidrag till Spitsbergens Molluskfauna, 1859, p. 138.
Type of genus: ?Mytilus vitrea Holböll in Möller 1842.
Remarks: This genus, erected for the small deep water species from the northern Atlantic, comprises species both from the Arctic and the Antarctic regions. One species, *Dacrydium pacificum,* is reported by Dall (1916) from the Bering Sea, in 1401 fms. This is the only report hitherto from the west coast of America.

The species of *Dacrydium* are all small, white, hyaline shells, with anterior umbones, internal resilium, and crenulated anterior margins. The type of the genus has also a thickened support for the anterior adductor. The new species described here seems to have to be placed in the genus *Quendreda,* which is supposed to be of subgeneric rank.

Subgenus **QUENDREDA** Iredale 1936

Quendreda Iredale, Rec. Austral. Mus., vol. 19, 1936, p. 271.
Type of subgenus: Dacrydium fabale Hedley 1904 (orig.).
Remarks: As is usual with generic names proposed by Iredale, there is no diagnosis. He states only that the species described by Hanley "differs in shape, form, and sculpture from the Spitzbergen shell, the type of Torell's genus." Hedley (1904), in the description of *fabale,* says: ". . . delicate, concentric growth-lines which rise into ridges on the ventral side. Hinge: a deep chondrophore, flanked by two prominent grooved cardinals." The two grooved teeth and the lack of a thickened

support for the anterior adductor separate this group from the typical species of the genus *Dacrydium*. Hedley's (1906) other species, *Dacrydium pelseneeri* from New Zealand, seems not to have the grooved teeth but is otherwise very like *fabale*. Without knowing the anatomy of the species referred to *Quendreda,* it is impossible to decide if it should be considered as a subgenus or a synonym of *Dacrydium*.

Dacrydium (Quendreda) elegantulum new species

Plate 8, fig. 41

Diagnosis: Shell small, hyaline with opaque white spots when fresh, or opaque white when dead and worn, oval, with the umbones anterior. Anterior margin with a broadly curved anteroventral angle, ventral margin straight, posterior and dorsal margins evenly curved. Umbones small, pointed. Periostracum thin, shining, growth lines widely spaced and like fine concentric sculpture, slightly raised anteroventrally; thicker calcareous layers forming radiating irregular bands on the younger parts of the valve, visible also in full grown and dead shells.

Hinge with small, toothlike thickenings of the margins on both sides of the deep-set resilifer beyond the umbo, the ventral "tooth" with three or four, the dorsal with five or six, striae or crenulations, the narrow margin connecting them also finely striated across. Along the dorsal margin the anterior part thickened and distinctly striated across, supporting a weak but distinct deep-set ligament. Muscular scars indistinct, anterior adductor placed close to the anteroventral margin.

Holotype: The Allan Hancock Foundation. One right valve of a young specimen, length, 2.4 mm; height, 1.4 mm.

Type loc.: Bahía de Gardner, Galapagos Islands (BS 453, Jan. 31, 1934); 35 fms.

Remarks: Compared to the Australian *Dacrydium fabale,* this species is easily recognized by its outline and the opaque radiating spots, as *D. (Quendreda) fabale* has a concave ventral margin and, as far as known, a uniform consistency of the shell. Most of the material at hand consists of loose valves more or less bored by minute organisms. Two complete but dried specimens were taken in the Galapagos Islands, as was also the fresh valve used as the holotype. The largest valve has a length of 4.5 mm.

Occurrence: Empty valves were taken in depths from 25 to 110 fms. The two living specimens and the type lot were from 25 to 35 fms, where the bottom consisted of rocks or coarse sand.

Distribution: Galapagos Islands; Baja California north to off Redondo Beach, California.

Genus ADULA H. and A. Adams 1857

Adula H. and A. Adams, Genera of Recent Mollusca, vol. 2, 1857, p. 517.

Type of genus: Mytilus soleniformis Orbigny 1846 (monotypy).

Remarks: Adula was described as a subgenus of *Perna* Adanson = *Modiolus* Lamarck with the following diagnosis: "Shell elongate, cylindrical, posterior side obliquely truncate, beaks sub-central." Only the type species was included in the new subgenus.

Although the four species here referred to *Adula,* which in my opinion constitutes a good generic unit, are rather different, they have several characters in common which serve to separate them from other mytilid genera. The elongate form simulates the species of *Lithophaga* and apparently the species are generally borers, too. They have the anterior byssal retractors fastened before the umbones, and the siphonal prolongations of the posterior part of the mantle are built like those found in *Lithophaga.* The sculpture of some species and the filthy covering of the posterodorsal triangle are also characters which make them look like a *Lithophaga,* and the gonads are extended into the mantle just as in that genus. There are, however, other characters typical for these species only. The posterior adductor, which is placed above the middle of the valve, is confluent with the posterior retractor muscles lying mainly in front of the adductor. Below the adductor are seen rather distinct scars of the retractors for the siphonal mantle prolongations. The umbones are placed farther back than in *Lithophaga,* and the anterodorsal margin is thickened. The crenulations on the margins vary considerably. Three species have distinct crenulations on the anterior margins, two have them also behind the ligament, while one species has completely smooth margins. Radiating sculpture on the lunule is found in two species, but not in the others.

Dall (1921) and other authors have considered *Adula* to be a subgenus of *Botula* Mörch; but they are very different and apparently not closely related. The strongly curved umbones and the peculiar place where the anterior retractor is fastened on the anterior thickened margin itself, make the species of *Botula* look very different from those of *Adula.*

The differences in the conchological characters of the four species here referred to *Adula* clearly show how dangerous it is to rely on one character only in separating mytilid genera. It would have been difficult to place *diegensis* in this genus without seeing the typical form of the pallial siphonal elongations and the same scar of the muscles as was observed in

the other species. These characters alone separate *diegensis* from the *Modiolus* group. *A. diegensis* is free-living, and therefore somewhat different from the other species, but the free-living habit alone is not sufficient to separate a species from its relatives in a genus.

Species of the genus *Adula* are distributed from Peru to British Columbia, and Japan. The genus is related to *Lithophaga* Röding, *Zelithophaga* Finlay, *Terua* Dall, Bartsch, and Rehder, and perhaps to *Botulopa* Iredale.

Key to the west American species:

1.	Shell with irregular vertical or wrinkled sculpture, margins without crenulations	*falcata* (Gould)
	Shell smooth or with radiating sculpture	2
2.	Radiating sculpture on the anterior part and before the keel, margins crenulated anteriorly and strongly so behind the ligament	*soleniformis* (Orbigny)
	Shell smooth or with few radiating striae anteriorly, posteriorly curved, with a filthy incrustation	3
3.	Shell elongate, not higher posteriorly than anteriorly, lunule generally without radiating lines	*californianus* (Philippi)
	Shell shorter, distinctly highest posteriorly, lunule generally with distinct radiating lines, which form internal ribs	*diegensis* (Dall)

Adula falcata (Gould) 1851

Plate 9, fig. 49

Lithodomus falcatus Gould, Proc. Boston Soc. Nat. Hist., vol. 4, 1851, p. 92.

Holotype: ?

Type loc.: Monterey, California.

Remarks: This species has the umbones near the anterior end. The peculiar sculpture of vertical or oblique or partly irregular wrinkles is typical for the species. The posterodorsal triangle has a filthy incrustation. The scars of the siphonal retractors consist of many small impressions just below the posterior adductor. The ventral siphon has irregular

margins like the smooth species. Two typical specimens in the collections are labelled Bahiá de la Independencia, Peru, and if correct, extend the distribution very far south.

Occurrence: Boring in clay or soft shale.

Distribution: Coos Bay, Oregon, to San Diego, California. Peru?

Adula soleniformis (Orbigny) 1846

Mytilus soleniformis Orbigny, Voyage dans l'Amérique Méridionale, vol. 5, Mollusques, 1846, p. 649, Pl. 85, figs. 17-18.

Holotype: ?

Type loc.: Neighborhood of Payta, Peru.

Remarks: This species, which is the type of the genus *Adula,* has the anterior retractor slightly before the umbones; a definite keel; and fine radiating lines on the anterior side and before the keel, very strong and riblike on the lunule. The anterior margin is thickened and crenulated; the ventral margin is smooth; the posterior margin is finely striated from the keel to the posterodorsal corner, where the surface is devoid of striation; the dorsal margin has strong, toothlike crenulations from behind the ligament to the posterodorsal corner. The resilial ridge and the nymphae are weak. The muscle scars were not observed (specimen examined, U. S. National Museum, Cat. no. 128635).

Occurrence: This species seems to be rather rare and apparently known only from the type locality. The habitat is unknown.

Distribution: Peru.

Adula californiensis (Philippi) 1847

Plate 9, fig. 50; text-figs. 73-74

Modiola californiensis Philippi, Ztschr. f. Malakozool., vol. 4, 1847, p. 113.

Syn.: Adula stylina Carpenter 1864.

Holotype: ?

Type loc.: Vancouver Island, British Columbia, Canada.

Remarks: Shell smooth, usually without radiating sculpture, sometimes with faint traces on the lunule. Anterior margin crenulated at least dorsally, and occasionally with obscure crenulations behind the ligament. Posterodorsal triangle with a filthy incrustation. Posterior third of shell not distinctly higher than anterior third. Byssus strong, in tufts from a main laterally compressed stem. The dorsal siphon with smooth margins and the margins of the ventral siphon furnished with irregular papillae.

Occurrence: Boring in soft shale, but now and then found fastened by the byssus to stones, indicating that this species does not always live as a borer. Generally living in the intertidal zone.
Distribution: Vancouver Island to San Diego, California; Japan.

Adula diegensis (Dall) 1911

Plate 9, fig. 51; text-figs. 75-76

Modiolus diegensis Dall, Nautilus, vol. 24, 1911, pp. 110-11.
Holotype: U. S. National Museum.
Type loc.: San Diego, California.
Remarks: Dall described this species as a *Modiolus* but said it resembled *Adula,* though not a borer, and it might possibly be referable to the genus *Myrina* H. and A. Adams. It seems, however, to have its correct place in the genus *Adula.*

The shell is smooth except on the lunule, where six radiating folds are seen, being especially distinct on the inside and forming teeth on the anterior margin. The periostracum is often covered by a filthy layer posterodorsally. The anatomy agrees with that of other species of *Adula.* The posterior extensible part of the mantle is furnished with papillae like those found in *Adula californiensis.*
Occurrence: Found on mud flats or piling, apparently always free-living. Intertidal.
Distribution: Charleston, Oregon, south to Cabo San Lucas, Baja California. La Libertad, Sonora, Mexico (Lowe collection, San Diego Museum).

Genus **LITHOPHAGA** Röding 1798

Lithophaga Röding, Museum Boltenianum, Part II, 1798, p. 156.
Syn.: Lithophagus Megerle von Mühlfeld 1811.
Lithodomus Cuvier 1817.
Dactylus Lang 1722, Klein 1753, Mörch 1861.
Type of genus: Lithophaga mytuloides Röding 1798 = *Mytilus lithophagus* Linné 1780.
Remarks: Species belonging to this genus are elongate with more or less parallel dorsal and ventral margins, a cylindrical shell, tapering posteriorly, and the umbones near the anterior end. The surface is sometimes irregularly sculptured. Sometimes nearly smooth, but always covered with a strong yellowish to dark brown or blackish periostracum, which never has hairy projections. The surface is often covered by a chalky in-

crustation, generally harder and thicker on the posterodorsal triangle and usually projecting beyond the posterior margin of the valve. The margins are always smooth and there are no toothlike crenulations in the hinge. The lunule is not defined.

The mantle margins are smooth except for the posterior part, which in preserved specimens is folded. The inner folds of the mantle, projecting posteriorly, form siphons, of which the ventral one is open below as is usual in mytilids. There are no visible scars formed by the siphonal musculature. The anterior adductor is elongate and rather large, placed near the margin; the posterior adductor is small and roundish. The anterior retractor of the byssus is fastened before the umbones and separated from the adductor; the posterior *retractores pedis et bysii* are continuous, small, and weak, and usually fastened above the posterior adductor. The byssal opening is behind the foot, large and with a functional gland, even in large specimens. The foot is small and pointed, with a ventral median furrow. The gonads are found in the mantle on both sides. All species bore in loose rock, corals, or the shells of other mollusks.

The genus *Lithophaga* has been divided into several "sections," mainly by Dall and Iredale, because of the differences in the chalky incrustation of the valves. These "sections" cannot be given the same value as the other groups of mytilids used in this paper, since there is a great deal of variation even among specimens of one population. It is sometimes very difficult to assign a specimen to a "section" on the basis of the characters given in the diagnosis alone. However, a few groups are useful in the classification, even if they generally do not indicate groups of species with different geographic distribution or those which seem to be genetically related. Small specimens or specimens with the incrustation cleaned off, are nearly impossible to classify.

Key to subgenera:

1. Valves without a calcareous incrustation *(Lithophaga s. s.)*
   Valves with a calcareous incrustation 2
2. Incrustation seen from behind oval and closed and with a vertical internal tube, which has one dorsal and one ventral opening *Stumpiella* n. subg.
   Incrustation otherwise, always without dorsal and ventral openings 3
3. The thickened part of the incrustation with irregular wrinkles more or less like a feather or with strong radiating grooves, and projecting distinctly beyond the valve *Diberus* Dall

Incrustation more uniform or the thickened part smooth or with a shallow divaricate pattern 4

4. The protruding incrustation or the ridges indicating the termination are crossed, generally with that of the right valve the lowest *Myoforceps* Fischer
Incrustation more uniform and alike on both valves without crossing projecting parts 5

5. Projecting part of incrustation generally rather long or ending in a median spine, smooth *Labis* Dall
Projecting part of incrustation, if present, short, surrounding posterior margin of valve *Leiosolenus* Carpenter

Subgenus **STUMPIELLA** new subgenus

Diagnosis: Shell with a triangular median area covered with a solid incrustation and bounded by a dorsal and a rather distinct ventral furrow. The incrustation has one dorsal and one ventral ridge terminating posteriorly in sharp angles, and is furnished with irregular wrinkles between the ridges, at least in the median part. The protruding incrustation is closed behind and furnished with one dorsal and one ventral opening connected by an internal channel.

Type of subgenus: Lithophagus calyculatus Carpenter 1856.

Remarks: The description given by Carpenter of his new species does not agree in all details with the three specimens at hand, but the peculiar projection of the incrustation seems to be such a good character that I think these shells can be referred to *Lithophaga calyculata* safely.

Lithophaga (Stumpiella) calyculata (Carpenter) 1856
Plate 10, figs. 61-63

Lithophagus calyculatus Carpenter, Catalogue of the Reigen Collection of Mazatlan Mollusca, 1856, pp. 124-125 *(non calyculatus* Hertlein and Strong 1946 = *plumula* Hanley).

Type loc.: Mazatlán, Mexico.

Holotype: British Museum.

Remarks: Shell rather high with a distinct dorsal angle, umbones near anterior margin, which is truncately rounded; ventral margin nearly straight, posterior margin concave, bounded by the two sharp angles formed by the protruding ridges of the incrustation. Seen from behind, the incrustation forms an oval closed area with slightly elevated median ridge and circumference; seen from the dorsal or ventral side, the incrustation has openings for a roundish channel passing through it. The dorsal

triangle is bounded by distinct dorsal and ventral furrows and is furnished with a bluish-white incrustation with vertical wrinkles, especially in the median part. Periostracum yellowish to yellow-brown, covered with a loose, granulated incrustation. Inside margaritaceous, posterior adductor relatively large and near posterior margin. Ligament shorter than half the length of the valve.

According to Carpenter, the type specimen measured 0.36 inches in length, 0.14 in height, and 0.15 in diameter. The two specimens from the Mexican islands in this material measure 15 mm by 7 mm and 14.2 mm by 6 mm, excluding the incrustation. The small Galapagos specimen has a length of 6 mm.

Occurrence: Apparently this species has not been obtained by collectors since Reigen did his collecting more than a hundred years ago and picked up the type specimen. It was therefore very interesting to find three examples of this apparently very rare species in the Hancock Collections. The three specimens were obtained on Isla Socorro and Isla Clarion on the shore, and at Isla San Cristobál (Chatham Island), Galapagos Islands, in a depth of 32 fms. The records are too few to allow a discussion of the occurrence of this species, but they seem to indicate an unusual type of distribution.

Distribution: Mazatlán, Mexico, to the Galapagos Islands.

Subgenus **DIBERUS** Dall 1898

Diberus Dall, Trans. Wagner Free Inst. Sci., vol. 3, 1898, p. 799.

Type of subgenus: Modiola plumula Hanley 1843.

Remarks: Dall (1898) says: "Resembling *Myoforceps,* but with two or more radial sulci extending backward from the beaks, with the incrustation plume like, arranged in a distinct pattern on the areas between the sulci, and, when projecting beyond the ends of the valves, apposited symmetrically, not alternate and twisted as in the last section."

The most conspicuous character separating species of *Diberus* from the other species of *Lithophaga* is the plumelike incrustation on the upper and posterior part of the valves. The anterior byssus retractor is fan-shaped where it is fastened to the valves and makes an elongate narrow scar from just behind the umbo halfway down the anterior slope. The posterior retractor scar is, at least in the west American species, placed above the posterior adductor and separated from it.

Iredale (1939) has named two sections from Australia, which seem to be identical with, or very close to, *Diberus, viz., Exodiberus,* type *Lithophaga calcifer* Iredale, and *Salebrolabis,* type *Lithophaga divaricalx* Iredale.

Subgenus *Diberus* is recorded from the Lower Miocene, Tampa, Florida (Dall, 1898, "Oligocene"), and the recent species occur in the warm and tropical seas on the east and west coasts of America, the Red Sea east to the Philippine Islands and Australia.

The west American species is well known as *Lithophaga plumula* (Hanley) 1843, with the variety *kelseyi* Hertlein and Strong 1946. Reeve, in Conchologia Iconica, has described *Lithodomus subula* from an unknown locality. The short description and figure 26 of Plate 4 seem to agree completely with the form named *kelseyi* by Hertlein and Strong. *Lithodomus pessulatus* Reeve 1857, also described from a specimen without locality, has vertical wrinkles on the anteroventral part of the valves. It will therefore be easily known if it should be found on the west American coast.

Lithophaga canalifera (Hanley) 1843 is considered a *Diberus* by Lamy (1937) and is here included in this subgenus, although the pattern of the incrustation is different. Lamy (1937) mentions *Lithophaga abbotti* Lowe in connection with species of *Diberus,* but according to the description it is not a *Diberus.*

Key to the west American species:

1. Incrustation with strong radiating grooves without a featherlike pattern — *canalifera* (Hanley)
   Incrustation with a featherlike pattern — 2
2. Shell rather high, more than 30% of length including incrustation; posterior adductor scar near posterior margin; at most its own length from the margin; incrustation distinctly like a feather with elevated ribs — *plumula* (Hanley)
   Shell lower, height about 25% of length including incrustation, posterior end more tapering; posterior adductor distinctly more than its own length from posterior margin; incrustation irregular and lower — *subula* (Reeve)

Lithophaga (Diberus) canalifera (Hanley) 1843

Text-fig. 78

Modiola canalifera Hanley, Catalogue of Recent Bivalve Shells, 1843, p. 239, Pl. 24, fig. 22.

Syn.: ?Lithophaga appendiculata (Philippi) Tomlin 1928.

Holotype: British Museum.

Type loc.: South America.

Remarks: Two small broken specimens from Manta, Ecuador, seem to be referable to Hanley's species, which has not been recorded since it was described. The specimens have a length of 11 mm, including the incrustation, which protrudes beyond the posterior margin for about 1.5 mm; on the right valve only in one of the specimens and on the left in the other, apparently indicating only the young age. The incrustation is found as two parallel thicker ridges separated by a radiating groove with more irregular sculpture. The anterior and ventral parts are covered with a thin granular incrustation. This species may perhaps be placed in subgenus *Labis,* but is retained in *Diberus* until more material is obtained. Tomlin (1928) has listed *Lithophaga appendiculata* (Philippi) (=*bisulcata* Orbigny, a West Indian species), from Isla Coiba, Bahía de Panamá, but perhaps his specimens may be referred to *Lithophaga (Diberus) canalifera* also.
Occurrence: 1 to 12 fms, sand.
Distribution: Panama?; Ecuador; South America.

Lithophaga (Diberus) plumula (Hanley) 1843
Plate 10, fig. 55

Modiola plumula Hanley, Catalogue of Recent Bivalve Shells, 1843, p. 239.
Syn.: Lithophagus calyculatus Hertlein and Strong 1946.
Holotype: British Museum.
Type loc.: Panama, in *Spondyli.*
Remarks: Carpenter (1857) admits two varieties or forms, a slender one, *gracilior,* and a shorter one, *tumidior.* The featherlike incrustation and the muscle scars are typical in both forms. The periostracum generally forms transverse wrinkles on the dorsal side. The largest specimen has a length of 55.8 mm including the projection of the incrustation, or 46 mm without; but ordinarily the specimens are 20 mm to 30 mm long. The anterior retractor leaves a narrow but very elongated scar commencing just behind the umbo.
Occurrence: The larger part of the specimens were collected in shallow water with corals, some were taken on or in rocks or sand, and a few were found in depths from 14 to 20 fms, where the bottom was stated to consist of sand and shells. All stations were within the known range of distribution, except for the one from Isla Española (Hood Island), Galapagos Islands, where the large specimen, total length 50 mm, was taken. It seems to have been unknown from these islands before.
Distribution: Gulf of California to Peru.

Lithophaga (Diberus) subula (Reeve) 1857

Plate 10, fig. 56

Lithodomus subula Reeve, Conchologia Iconica, Lithodomus, 1857, Pl. 4, fig. 26.

Syn.: Lithophaga plumula kelseyi Hertlein and Strong 1946.

Holotype: British Museum.

Type loc.: ?

Remarks: The differences between *Lithophaga plumula* and the species which here is named *Lithophaga subula,* are small but constant. Whether they are considered to be specific or subspecific is a matter of subjective opinion. As far as can be decided from the published short description and figures, Reeve's *subula* is identical with the subspecies named *kelseyi* by Hertlein and Strong.

The incrustation, when it is featherlike, is decidedly stronger on the ventral part. Some specimens show the transverse wrinkles of the periostracum more common in *L. plumula.* The dorsal angle is more pronounced than that of *L. plumula,* and the form of the shell is decidedly more elongate and lower; but the position of the posterior adductor relative to the posterior margin seems to be the most reliable character.

The largest specimen measures 56.6 mm, including the incrustation.

Occurrence: This species is very common along the coast of California to the south of Point Conception and is found on the west coast of Baja California south to Punta Pequeña. It is found living from the shore down to 35 fms. The record from Catalina Island, 350-400 fms, must be due to an error, as the piece of cemented broken shells in which the specimens were living has small algae growing on it. In the California Academy of Sciences are preserved specimens from Cosacos River, Alaska.

Distribution: Baja California to Point Conception, Alaska.

Subgenus MYOFORCEPS Fischer 1886

Myoforceps Fischer, Manuel de Conchyliologie, 1886, p. 969.

Type of subgenus: Modiola caudigera Lamarck 1819 = *Mytilus aristatus* Dillwyn 1817 (monotypy).

Remarks: The diagnosis given by Fischer is very short and contains only one character, the crossed projecting portion of the incrustation. This character generally is sufficient for the recognition of the subgenus. Apparently this subgenus contains only one species, as the two species mentioned by Lamy (1937) in connection with *Lithophaga aristata, viz., Lithophaga bipennifer* Guppy 1877 and *Modiola (Lithodomus) excavata* De Folin 1867, seem to be referable to the same widely distributed species.

Lithophaga (Myoforceps) aristata is recorded from the Lower Miocene, Tampa, Florida, by Dall, and from the Pleistocene, Galapagos Islands, by Hertlein and Strong.

Lithophaga (Myoforceps) aristata (Dillwyn) 1817

Plate 10, figs. 53-54

Mytilus aristatus Dillwyn, Descriptive Catalogue of Recent Shells, vol. 1, 1817, p. 303.

Syn.: Modiola caudigera Lamarck 1819, Dall 1898, 1909.
Lithophaga caudatus Gray 1827.
Dactylus carpenteri Mörch 1861.
Lithodomus forficatus Ravenel 1861, Dall 1889.

Holotype: ?

Type loc.: Senegal.

Remarks: Generally specimens of this species are easily recognized by the crossing projections of the incrustation. Sometimes the incrustation has no real projections, the posterior part being truncate, and the typical crossing of the posterior part of the incrustation seems to be absent; but by careful inspection, one will find a thickened ridge on each valve, generally on the ventral side of the right valve. If these ridges had projections, they would cross each other. Among the sixty samples of this species from the west coast of America, only two specimens had the ridge or projection on the dorsal side of the right valve. The form of the shell is rather variable and Carpenter (1857) has named two varieties, *gracilior* and *tumidior*. The variations of the outline seem to be caused by the shell being bored into or by other ecological circumstances, and so do not represent different populations.

Carpenter (1857) said his largest specimen measured 1.56 inches. One Hancock specimen from Ecuador (403-35) has a length of 43.2 mm.

The posterior adductor is rather large and closer to the posterior margin of the valve than its own length. The anterior protractor is narrow and relatively short.

Occurrence: Nearly all localities where *Lithophaga aristata* has been collected are shallow water, from shore to a depth of 5 fms. It was therefore astonishing to see that living specimens were collected at a depth of 165 fms (529-36). This species seems to be a borer of other mollusks and apparently very rarely attacks stone directly. All localities in the Hancock collections of *Lithophaga aristata* are within the previously known range of distribution of the species.

Distribution: La Jolla, California, to Peru. Atlantic: West Indies, west Africa, Mediterranean; Red Sea; Australia; Japan.

Subgenus **LABIS** Dall 1916

Labis Dall, Proc. U. S. Natl. Mus., vol. 52, 1916, pp. 405-406.
Type of subgenus: Lithophaga attenuata Deshayes 1836 (monotypy).
Remarks: This "Section" was described for *attenuata* alone, characterized by the "smooth appendage of which the distal end is internally flattened and somewhat separated from the appendage of the opposite valve, the ends being rounded." It seems useful to include *Lithophaga cumingiana* (Reeve) 1858 and *Lithophaga peruviana* (Orbigny) 1846 in the same subgenus, as proposed by Lamy (1937). The main characteristic of *Labis* will then be the smooth appendage projecting beyond the posterior margin of the valve. The anterior retractor seems also to be shorter and broader than in the other *Lithophaga* species.

Species of this group are restricted to the west coast of Central and South America and Australia, where Iredale's (1939) section *Doliolabis* seems to be identical.

Key to the west American species:

Projecting posterior part of the incrustation long, rounded apically	*attenuata* (Deshayes)
The projecting posterior part of the incrustation short, with a median spine	*peruviana* (Orbigny)

Lithophaga (Labis) attenuata (Deshayes) 1836

Plate 10, fig. 57; text-fig. 77

Modiola attenuata Deshayes, Animaux sans Vertèbres, ed. 2, vol. 7, 1836, p. 28.
Syn.: Lithodomus inca Orbigny 1846.
Holotype: ?
Type loc.: Peru and Chile.
Remarks: The incrustation on the ventral side is sometimes arranged in vertical rows; the posterior projection of the incrustation is sometimes long, up to 20 mm, sometimes very short, but always without a median ridge; the inside of the projection is more or less hollowed out, forming a median cavity when the valves are closed. The median incrustation often has a pattern of radiating but not divaricating lines and the edges of the projecting part are irregularly granulated. There seem to be two different forms, an elongate slender one and a shorter thicker one, which apparently occur in different localities.

The height to length ratio varies from small specimens to large ones, the smaller being relatively higher, so that specimens of approximately the same size must be compared. A few measurements will show this, and also the differences in form.

	Length in mm without incrustation	H/L ratio
Peru	80.0	23.1
Ecuador	63.2	25.3
	29.2	27.4
	16.8	30.0
Costa Rica	81.5	25.7
	61.0	26.3
Lower California	59.0	32.7
	29.3	34.8
	13.8	42.0
	62.5	30.0
	55.0	29.1
	49.0	30.6
	28.2	32.0

The type locality for both *Lithophaga attenuata* (Deshayes) and *Lithodomus inca* Orbigny is Peru and apparently they both belong to the slender form and are synonymous, especially as Orbigny (1846) gives no records of *attenuata* Deshayes. The H/L ratio for *L. inca* is given as 24. The differences in form between the typical southern elongate specimens and the northern shorter ones are rather distinct; but without a larger amount of material it is not advisable to give the northern form a subspecific name.

The largest specimen, from Costa Rica, has a total length of 100 mm, or 81.5 without the incrustation.

Occurrence: Most of the collecting was done in shallow water, but several samples were collected in deeper water down to 45 fms. All samples are from within the known range of distribution.

Distribution: Miller's Landing, Baja California, to Chile (Hertlein and Strong).

Lithophaga (Labis) peruviana (Orbigny) 1846

Plate 10, fig. 58

Lithodomus peruvianus Orbigny, Voyage dans l'Amérique Méridionale, vol. 5, Mollusques, 1846, p. 651.

Holotype: ?

Type loc.: Callao, Peru.
Remarks: The description is very short but it agrees completely with a large species of *Lithophaga* with a median spinelike posterior projection of the incrustation, which in itself is not so heavy as that found in *Lithophaga attenuata.* The posterior retractor is dorsal to and separated from the posterior adductor.

Orbigny gives 71 mm as the total length, with an H/L ratio of 31. Our specimens are distinctly lower, with a ratio of 23 or less. The largest specimen measures 71 mm without the projecting incrustation, which in these specimens shows a tendency to be different on each valve.
Occurrence: Orbigny says that this species is very common along the coasts of Peru, living in loose rock or in the bones of whales. The samples at hand were taken in depths ranging from 10 to 18 fms; only one small specimen was obtained by shore collecting.
Distribution: Peru.

Subgenus **LEIOSOLENUS** Carpenter 1856

Leiosolenus Carpenter, Catalogue of the Reigen Collection of Mazatlan Mollusca, 1856, p. 130.
Type of subgenus: Leiosolenus spatiosus Carpenter 1856 (by monotypy).
Remarks: The short diagnosis given by Carpenter contains only the supposition that the animal should have a long excurrent siphon, while the chambers have bilobed pipes. His new species, *Leiosolenus spatiosus,* was based on only one specimen, 1.5 inches long, and the short description gave as specific character the thin and equally diffused incrustation without projecting parts. On p. 550 in the Appendix, he reported another specimen, 2.3 inches long. *L. spatiosus* seems not to have been obtained later under that name.

Mörch (1861) referred *Lithophagus rugiferus* (Dunker) Reeve 1857, description published by Carpenter (1856), to the genus *Leiosolenus* on the basis of certain anatomical characters, especially the elongate siphons; and he also placed *Lithophaga patagonica* (Orbigny) 1846 in the same genus. This character seems, however, to be more or less common for all species of nearly all groups of *Lithophaga.* Lamy (1937) gives, as the character separating *Leiosolenus* from the other groups, the thin, more uniform incrustation without appendages projecting beyond the posterior margin; but in characterizing the various species referred to *Leiosolenus,* he mentions several with more or less projecting incrustation.

Species belonging to this group are found mainly in the Pacific. There seems to be reason to consider *Lithophagus rugiferus* Reeve 1857 and *Lithophaga abbotti* Lowe 1935 as synonyms of *L. spatiosa* Carpenter

1856. One species with typical incrustation seems to be new to science. Key to west American species:

Incrustation thin, tending to be arranged in transverse rows of pustules	*spatiosa* (Carpenter)
Incrustation loose, chalky, forming a divaricating pattern on the posterior part	*hancocki* n. sp.

Lithophaga (Leiosolenus) spatiosa (Carpenter) 1856

Plate 10, fig. 59

Leiosolenus spatiosus Carpenter, Catalogue of the Reigen Collection of Mazatlan Mollusca, 1856, pp. 130-131.

Syn.: ?Lithophagus rugiferus Carpenter 1856.
?Lithophaga abbotti Lowe 1935.

Holotype: British Museum

Type loc.: Mazatlán, Sinaloa, Mexico.

Remarks: The descriptions of this species and of the subgenus *Leiosolenus* are very short and based mainly on the chambers made by the boring bivalve. The main characters of the bivalve are the short, bent shell, with well rounded ends, barely angled dorsal margin, and slight excurvature in front. The incrustation is thin, equal over all the surface and tending to be arranged in transverse rows of pustules. It seems to be a large species, though the length of the type, which is supposed to be a young specimen, is only one and a half inches. As far as I can see, this species has not been recognized since it was described by Carpenter; but it is very possible that *Lithophagus rugiferus* Carpenter and *Lithophaga abbotti* Lowe should be referred to the same species.

L. spatiosa represents one of the largest species, with length up to 62.5 mm *(abbotti* Lowe). The incrustation is variable but usually some transverse rows of pustules can be observed on fresh specimens.

Occurrence: The records are from the shore down to 15 fms, boring in valves of *Pinctada* and *Ostrea (rugiferus* Carpenter).

Distribution: From Ecuador *(rugiferus)* to San Felipe, Gulf of California *(abbotti).*

Lithophaga (Leiosolenus) hancocki new species

Plate 10, fig. 60

Diagnosis: Shell elongate, cylindrical, rather inflated, two and a half to three times as long as the maximal height; umbones nearly terminal, anterior margin rounded, ventral margin nearly straight with a rounded posterior margin, dorsal margin with a more or less distinct median

angle. Periostracum light, yellowish-brown. The whole surface covered by a loose chalky incrustation; the triangle from the umbo to the posterior margin bounded by an indistinct ventral furrow and a very shallow dorsal depression, with an incrustation which forms a divaricating pattern and is more solid toward the posterior margin, where it generally projects slightly beyond the valve, with irregular granulated margins.

Anterior retractor relatively short, posterior retractor above the adductor, which is as far from the posterior margin as one and a half times its own length. Nymphae and resilial list narrow and weak. The maximal length is 38 mm.

Holotype: Allan Hancock Foundation. Measurements: length, 32 mm; height, 10.8 mm; diameter, 10 mm.

Type loc.: Isla Onslow, north of Isla Floreana (Charles Island), the Galapagos Islands (804-38).

Remarks: The loose, often rather thick, incrustation, especially on the anterodorsal part, and the divaricate pattern on the posterodorsal triangle, together with the lack of projecting parts of the incrustation, are characters which make the recognition of this species very easy. As far as can be seen, no other species of *Lithophaga* combining these characters has been described, though the new species seems to be very like a Japanese species reported as *L. lima* Lamy 1919, a Red Sea species.

It is a pleasure to dedicate this species to Captain Allan Hancock, whose interest in the exploration of the marine life in the eastern Pacific has made this rich collection possible.

Occurrence: Fifty two specimens out of a total of sixty nine were found in the crater on Isla Onslow, Galapagos Islands, apparently boring into loose coral *(Pavona)* in shallow water. One specimen was taken at a depth of 13 fms, on rocky bottom. Three typical specimens from Isla Taboguilla, Panama, from the Lowe collection, are preserved in the San Diego Museum (cat. no. 28374, C. A. Reed *leg.).*

Distribution : The Galapagos Islands; Panama.

LIST OF MATERIAL OF THE FAMILY MYTILIDAE PRESERVED IN THE ALLAN HANCOCK FOUNDATION COLLECTION

The list of stations under each species is arranged as correctly as possible from north to south, after the records at hand. Place names are given as listed in the Millionth Map of Hispanic America, American Geographical Society. Alternative names for stations occupied by the *Velero III* from 1931 to 1942 will be found in the Allan Hancock Pacific Expeditions, Volume 1, number 3. The numbers marked BS are mud sample stations taken separately, and alternative names for these will be found in the Allan Hancock Pacific Expeditions, volume 6. Other numbers represent stations at which collections were made by members of the Allan Hancock Foundation staff, or by others.

The stations lying within a line from Cabo San Lucas, Baja California and Cabo Corrientes, Jalisco, Mexico, are recorded as from the Gulf of California.

Dead specimens and loose valves are listed as valves.

Station	Location	Depth	Remarks	Specimens
MYTILUS EDULIS LINNÉ				
Alaska				
29304	Alaska			one small
Acc. 1081	Controller Bay			three valves
Oregon				
1480-42	Old railroad spur, pier and loose rocks on mud flats, Yaquina Bay	Intertidal	Loose rock, mud banks	many large
1476-42	Old submerged jetty, Coos Bay	Intertidal	Loose rocks, tide pools, kelp holdfasts	four
	Hallmark Dock, Charleston			five
1485-42	Hallmark Dock, Charleston	Intertidal	Worm tubes from piles and floats	many large
	Charleston			four
1474-42	N of bridge, east side, Charleston	Intertidal	Mud and sand flats	two
1464-42	S side, Sunset Bay, Coos Co.	Intertidal	Loose rocks, sand, kelp holdfasts, tide pools	one
California				
EB 2	Albion River estuary, Mendocino Co.	South shore, near station	Algae covered rocks on mudflats	six
M 88-49	Off Fort Ross, Sonoma Co.	120 fms (!)		two
M 70-49	Bodega Lagoon, Sonoma Co.		Clam beds	many
M 67-49	Bodega Lagoon, Sonoma Co.			many
1797-49	Mussel Pt., 2 mi N of Bodega Head, Sonoma Co.			five and several juvenile
1669-49	Horseshoe Cove, 2 mi N of Bodega Head, Sonoma Co.			two
M 65-49	Shirttail Gulch, Bodega Bay, Sonoma Co.			two
1815-49	North Jetty, Bodega Bay, Sonoma Co.			three
1814-49	North Jetty, Bodega Bay, Sonoma Co.			two
1802-49	North Jetty, Bodega Bay, Sonoma Co.			many
1796-49	Campbell's Cove Bodega Lagoon, Sonoma Co.			one
1794-49	Campbell's Cove Bodega Lagoon, Sonoma Co.			two
	Bodega Bay	Beach		one

Station	Location	Depth	Remarks	Specimens
1658-48	W side, near entrance to Bodega Bay, Sonoma Co.			eleven
1675-49	0.5 mi N of mouth of Salmon Creek, Sonoma Co.			many
1607-48	Dillon Beach, Marin Co.	Shore	Exposed rocky coast, sand	one
1655-48	Nick's Cove, Tomales Bay, Marin Co.		Coarse to fine sand, rock	four
1608-48	Tomales Pt., Marin Co.	Bluff		two
M 69-49	Tomales Bay, Marin Co.	3-5 fms	Loose rocks	four
1612-48	Hamlet, Tomales Bay, Marin Co.		Fine mud	ten
1590-47	Elkhorn Slough, 22 mi N of Pacific Grove, Monterey Co.		Sand flats	two valves
	Point Dume			one
H 47-74	Channel Islands			three
	Redondo Beach			one
1593-47	Hermosa Beach		Pilings	several
	Palos Verdes			one
	Portuguese Bend			six valves
	Cabrillo Beach			two valves
1638-48	Outer Harbor, San Pedro		Scrapings from buoys and pilings	many
	San Pedro			two
	San Pedro	Rocky beach		many
	Los Alamitos Bay, Long Beach			two valves
1449-42	Off Fred Lewis' Landing, Newport Harbor	Intertidal	Harbor floats and piles	five
	Off Balboa Yacht Club			many
1930-50	Corona del Mar	Shore	Sand, rocks, eel grass	one
	Corona del Mar	Beach		seven
2131-52	Newport Bay to Corona del Mar	Shore	Coarse sand, eel grass	one
1218-40	Laguna Beach	Site of old pier	Reefs at low tide	one small
Acc. 176	Catalina I.			many small
1238-41	Off Wilson Cove, San Clemente I.	14-16 fms	Kelp, gray sand	one valve
1506-46	La Jolla	Intertidal	Reefs, caves	one
1603-47	Reef S of Beach Club, La Jolla			one
	Mission Bay, San Diego			two and two valves

Mexico: Gulf of California				
1070-40	Bahía de San Felipe	3 fms	Mud	one small
MYTILUS CALIFORNIANUS CONRAD				
Oregon				
1477-42	Agate Beach under Yaquina Head light	Rocky reef	Mussel bed, kelp, tide pools, loose rocks	seventeen
1480-42	Old railroad spur and pier, Yaquina Bay	Intertidal	Loose rocks, mudflats	one
1466-42	North side, Sunset Bay, Coos Co.	Intertidal	Mussel reefs, sandstone ledges, tide pools	three
1464-42	South side, Sunset Bay, Coos Co.	Intertidal	Loose rocks, sand, kelp holdfasts, tide pools	nine
1468-42	Middle Bay, Cape Arago State Park, Coos Co.	Intertidal	Rocks, kelp, tide pools	two
1492-42	South Bay, Cape Arago State Park, Coos Co.	Intertidal	Loose rocks, tide pools, kelp	many
California				
EB 42	Albion Bay, Mendocino Co.	Mouth of river		three
EB 41	Point Arena	Wide, flat reef		five
EB 37	Salmon Pt., Mendocino Co.	Shore	Rocky, with tide pools	one
EB 15	Salmon Pt., Mendocino Co.		Spray zone	two
EB 12	Salmon Pt., Mendocino Co.		Mussel beds	many
1671-49	East Beach, 1 mi N of mouth of Russian River, Sonoma Co.			six
1627-48	Carmet, 1 mi N of Salmon Creek, Sonoma Co.			two
1677-49	Horseshoe Cove, 2 mi N of Bodega Head, Sonoma Co.			two large, many small
M97-49	Shell Beach, N end, Bodega Bay, Sonoma Co.			one valve
M70-49	Bodega Lagoon, Sonoma Co.		Clam beds	three
1802-49	North Jetty, Bodega Bay, Sonoma Co.			two valves
1815-49	North Jetty, Bodega Bay, Sonoma Co.			two
	Bodega Bay beach, Sonoma Co.			one
M71-49	South Jetty, Bodega Bay, Sonoma Co.			three
1653-48	Second Sled Road, Dillon Beach, Marin Co.		Rocks, sand	three, several small
1607-48	Dillon Beach, Marin Co.		Exposed rocky coast, sand	ten
1608-48	Tomales Pt., Marin Co.		Bluff	four small

Station	Location	Depth	Remarks	Specimens
1628-48	Tomales Bluff, bay side, Marin Co.		Rocky coast, substratum of coarse sand and rock	one
1656-48	Tomales Pt., bay side, Marin Co.		Coarse sand, granite boulders	many
	Tomales Bay Head			one
1604-47	Point Piños, Monterey Co.		Shore collecting	one small
	Pacific Grove			three
1579-47	0.5 mi W of Cayucos, San Luis Obispo Co.		Rocky reefs	twelve
1583-47	4.5 mi W of Cayucos, San Luis Obispo Co.		Rocky reefs	twelve
1581-47	Leffingwell Landing, near Cambria, San Luis Obispo Co.		Rocky reefs, tide pools	one
1598-47	Piedras Blancas, San Luis Obispo Co.			five
1575-46	6.7 mi S of Surf (Pedernales Pt.), Santa Barbara Co.		Cliffs, stacks, exposed reefs	six
1574-46	3 mi S of Seacliff, Ventura Co.		Rock patches, sandy beach	two valves
1315-41	Olive Mill Road, Montecito	Shore	Algae covered rocks, underlaid with sand	five
	Point Mugu			four
1297-41	0.5 mi E of San Pedro Pt., Santa Cruz I.	26-40 fms	Rocky	many
883-38	Tyler Bight, San Miguel I.	Shore	Rock	three
1664-48	Willow Anchorage, Santa Cruz I.	Rocky reef, islet	Protected	five
1193-40	Willow Anchorage, S side, Santa Cruz I.	Beach	Low tide	two
1199-40	E of Gull I., S of Santa Cruz I.	11-19 fms	Mud, sand, algae, kelp, rocks	one
	Point Dume			many
	Topanga Canyon, Santa Monica			seven
	Venice Biological Station			one
Acc. 186	Venice			six
1208-40	Playa del Rey	Old pier	Low tide	many
	Redondo Beach			one
1593-47	Hermosa Beach	Pilings		two large, several small
	Hermosa Beach			many
	Palos Verdes			four
1573-46	Palos Verdes, near Bluff Cove	Intertidal	Rocky shore	three
	Portuguese Bend			one valve

Acc. 573	Point Vicente			seven
Acc. 555	White's Pt.			one
	San Pedro breakwater			four
1230-41	San Pedro breakwater	Shore		one
1445-42	Anaheim Landing	West shore	Mud, eel grass, sand	six
Acc. 655	Anaheim Landing			many
905-38	Anaheim Slough, near Long Beach	Shore	Sand, mud, *Zostera*	four valves
	Anaheim Slough, near Long Beach			many
	Santa Barbara I.	Shore		four
	Corona del Mar			two valves
1014-39	S of breakwater, Corona del Mar	Shore	Rock, sand	five
1225-40	SE of Newport, breakwater	Shore		one
	Laguna Beach			one
1218-40	Laguna Beach	Site of old pier	Reefs at low tide	four small
1130-40	Off Abalone Pt., Laguna Beach	25-29 fms	Mud	one, five valves
1623-48	Cherry Cove, Isthmus, Catalina I.	Shore	Protected rocky shore	two
1646-48	Long Pt., Catalina I.	Shore	Rocky headland	one valve
Acc. 495	Catalina I.			one
	Abalone Cove, Catalina I.			four
1206-40	Off Dutch Harbor, San Nicolas I.	4-9 fms	Fine sand	one
1506-46	La Jolla	Intertidal	Reefs and caves	one and two valves
2013-51	Rocky Point, San Quentin Bay	Shore	Rocky outcrops in lagoon	one
Mexico: Baja California, Pacific coast				
Acc. 496	South island, Islas Coronados			seven
1597-47	N of Punta Descanso, near Islas Coronados	Rocky reef		one small
	Ensenada			two
1594-47	Punta Descanso		Rocky	two
1505-46	Near Punta Descanso	Intertidal	Rocky reefs	three
1595-47	Mouth of Rio de Santo Tomás, between Punta Santo Tomás and Punta San José		Rocky reef	one
H 46-59	N of Rio San Isidro			six valves
1504-46	Cabo Colnett	Intertidal	Rocky shore	six
Dawson 5	Punta Santa Rosalía	Shore		two small
1508-46	Miller's Landing, S of Punta Rosarita		Cobble reef	one
1704-49	Cove, W end of S Bay, Isla de Cedros	Shore	Rocky beach	one large

Station	Location	Depth	Remarks	Specimens
2603-54	1.1 mi NNE of Kelp Pt., Puerto de San Bartolomé	Shore	Rocky ledge, kelp	five
SEMIMYTILUS ALGOSUS (GOULD)				
Ecuador				
	Guayaquil			one small
Peru				
369-35	Off Isla de Frontón, near Callao	5 fms	Rock	two valves
837-38	North island, Islas de Chincha	Shore	Rock	many
375-35	E of Isla de las Viejas, Bahía de la Independencia	Shore	Sand	many
380-35	Bahía de la Independencia	Shore	Rock	two
CHOROMYTILUS CHORUS (MOLINA)				
Peru				
380-35	Bahía de la Independencia	Shore	Rock	two small
CHOROMYTILUS PALLIOPUNCTATUS (CARPENTER)				
Mexico: Gulf of California				
BS 2155	Bahía de San Jose del Cabo	17-25 fms		one valve
Mexico				
276-34	Bahía Tenacatita	Shore	Rock	nineteen, from 7.5 to 51 mm
121-33	Bahía Tenacatita	Shore, head of bay	Rock, sand	one valve
265-34	Bahía de Petatlán	5-10 fms	Hard sand, shell	two valves
Dawson 94	Salina Cruz, Oaxaca	Shore, rocky headland	Granite rock, heavy surf, tide pools, mussels abundant, T 24.9° C.	several
Dawson 95	S of Salina Cruz, Oaxaca	Shore	Rock with *Ectocarpus*, T 25° C.	nine, and one valve
Panama				
438-35	Puerto Piñas	25 fms	Coarse sand	one valve

AULACOMYA ATER (MOLINA)
Peru

364-35	Off Isla de San Lorenzo, near Callao		Sand	one dead, almost without radial sculpture
388-35	Off Middle island, Islas de Chincha	3-8 fms	Kelp, sand	three large, one small
387-35	Off Middle island, Islas de Chincha	5 fms	Sand	four large, many small
386-35	Off Middle island, Islas de Chincha	8 fms	Sand	one small
384-35	Bahía de la Independencia	5 fms	Rock	two valves
820-38	Bahía de San Nicolás	10-25 fms	Mud	one, length 106 mm, violet-red

HORMOMYA GRANULATA (HANLEY)
Peru

391-35	Islas Lobos de Afuera	Shore	Rock	two
831-38	Bahía de la Independencia	Shore	Rock	one
376-35	E of Isla de las Viejas, Bahía de la Independencia	7 fms	Rock	two valves
825-38	Bahía de San Juan	Shore	Rock	three

HORMOMYA ADAMSIANA (DUNKER)
California

1189-40	Santa Cruz Island	Beach	Heavy shingle	five
Acc. 696	Santa Cruz Island			one
	Venice			five valves
	Portuguese Bend			two valves
Acc. 1155	Point Fermin			one
1209-40	Laguna Beach	Shore	Rocky and underlaid. Heavy covered sand	four valves
1218-40	Laguna Beach, site of old pier	Reefs	Low tide	two valves
1130-40	Off Abalone Pt., Laguna Beach	25-29 fms	Mud	two valves
Acc. 495	Isthmus Cove, Catalina I.			several
1646-48	Long Pt., Catalina I.	Shore	Rocky headland	two
1367-41	White Cove, Catalina I.	Shore	Kelp from shore rocks	eight
1221-40	Avalon, Catalina I.	Shore	Rock	one

Station	Location	Depth	Remarks	Specimens
Mexico: Baja California, Pacific coast				
Acc. 496	South island, Islas Coronados			several
Dawson 5	Punta Santa Rosalía	Shore		five
Dawson 9	Punta Rosarita on Bahía Rosarita	Shore	Rocky headland	several
Dawson 14	Miller's Landing, S of Punta Rosarita	Shore	Flat cobblestone reef	fourteen
1946-50	East island, Islas San Benito	Shore	Rock, eel grass, turnable boulders	one
	Isla de Cedros			three
1704-49	Cove, W end of South Bay, Isla de Cedros	Shore	Rocky beach	three
2064-51	Nameless Cove, 12 mi E of Punta Eugenia	Shore	Rock, shingle	one
2022-51	10 mi W of Punta Malarrimo	Shore	Rock, reef, tide pools	one
2080-51	Hancock Cove, 20 mi E of Punta Eugenia	Shore	Rock	many
2603-54	1.1 mi NNE of Kelp Pt., Puerto de San Bartolomé	Shore	Rocky ledge, kelp	one
Mexico: Gulf of California				
1049-40	Puerto Refugio, Isla Angel de la Guarda	Shore	Rocky reef	many
724-37	N of Punta Lobos, Sonora	Shore	Rock	two
537-36	Bahía de los Angeles	Shore	Sand	one, small
700-37	Bahía de los Angeles	Shore	Shingle	one
739-37	Ensenada de San Francisco, Sonora	Shore	Shingle	one
BS 2020	Punta Púlpito	17 fms		one valve
1747-49	Puerto Escondido, S of Loreto	7 fms		one
1774-49	Puerto Escondido, S of Loreto	Shore	Rocky beach	five
Dawson 68	Mazatlán, Sinaloa, N of Olas Altas light	Shore	Rocks, pools	two
Dawson 69	Mazatlán, Sinaloa, S side of Olas Altas light	Shore	Reefs, rocks	one valve
623-37	Cabeza Ballena	Shore	Rock, tide pools	one
Dawson 53	Cabeza Ballena	Shore	Granite reef	many
2588-54	Isla Isabel	0-3 fms	Rock	one
749-37	Isla Isabel	Rocky reef	Low tide	five
Mexico				
Dawson 85	Barra Navidad, Jalisco	Shore	Lagoon	many
2591-54	Rocas de San Lorenzo, Acapulco	0-2 fms	Rock	many
Dawson 131	Acapulco, end of seaward peninsula, opp. I. Roqueta	Shore	Reef	four

260-34	El Bufadero, Bahía Tangola Tangola	Shore on small island in bay	Rock	two
Dawson 94	Salina Cruz, Oaxaca	Shore on rocky headland	Heavily surf-beaten granite rock, tide pools	one
Costa Rica				
466-35	Puerto Parker, opp. Punta Abajo	Shore of small island at entrance	Rock	five
256-34	S of Punta Mala	Shore	Rock	many
Panama				
866-38	Islas Secas	Shore	Rock	one
BS 332	Off North Island, Bahía Honda	30-50 fms		one small, one valve
Galapagos Islands				
800-38	Bahía de Cartago, Isla Isabela (Albemarle I.)	North shore	Rock	one small
187-34	Bahía de Cartago, Isla Isabela (Albemarle I.)	8-10 fms	Sand with rock patches	three valves
56-33	Bahía Flamingo, off Punta Cormorant, Isla Floreana (Charles I.)	Shore	Rock	two
Ecuador				
211-34	Isla La Plata	Shore	Rock	eleven
	La Libertad			one
16-33	Bahía de Santa Elena, S of La Libertad	Shore	Rock	two
SEPTIFER BIFURCATUS (CONRAD)				
California				
1576-47	0.5 mi N of Cayucos, San Luis Obispo Co.	Protected reefs	Rocks, pools	three
1579-47	0.5 mi W of Cayucos, San Luis Obispo Co.	Rocky reef		two
1599-47	Breaker Point, near Piedras Blancas, San Luis Obispo Co.			two
1585-47	Wood Mar, 5 mi E of Gaviota Beach, Santa Barbara Co.	Sandy beach	Shale outcrops	seven
1448-42	Pt. Arguello, U. S. C. G. Life Boat Station outside breakwater	Intertidal	Rocks, sand, kelp	one
1315-41	Olive Mill Road, Montecito	Shore	Algae covered rocks overlaid with sand	two

Station	Location	Depth	Remarks	Specimens
1660-48	SW shore of Smugglers Cove, Santa Cruz I.	Shore	Rocky reef, loose rock, gravel	four
1193-40	Willow Anchorage, S side, Santa Cruz I.	Beach	Low tide	one small
	Venice Biological Station			one
Acc. 189	Venice			two valves
Acc. 186	Venice			five valves
1013-39	Portuguese Bend	Shore	Rocks, reefs	two valves
	Portuguese Bend			two
Acc. 587	Pt. Vicente, near Rocky Pt.	12 fms		one
Acc. 575	Pt. Vicente			three valves
Acc. 573	Pt. Vicente			one
Acc. 574	Pt. Fermin			three
1222-41	Newport and Balboa Channel	Shore	Low tide	one
	Corona del Mar	Beach		three
1130-40	Off Abalone Pt., Laguna Beach	25-29 fms	Mud	eleven valves
Acc. 1172	Laguna Beach			one
BS 1248	8.5 mi E of Long Pt., Catalina I.	228 fms		one small piece
	Abalone Cove, Catalina I.			one
Acc. 335	Catalina I.			two valves
1205-40	S side of San Nicolas I.	20-34 fms	Green sand	one valve
BS 1002	Northwest Anchorage, San Clemente I.	20 fms		two valves
1025-39	Horse Cove, near Pyramid Cove, San Clemente I.	Shore	Rock, tide pools	many
1506-46	La Jolla	Intertidal	Reefs and caves	one
1603-47	Reef S of Beach Club, La Jolla			four
Mexico: Baja California, Pacific coast				
1594-47	Punta Descanso		Rocky	four
1505-46	Near Punta Descanso	Intertidal	Rocky reef	four
1596-47	Mouth of Rio de Santo Tomás, between Punta Santo Tomás and Punta San José		Rocky reef	one
1595-47	Mouth of Rio de Santo Tomás		Rocky reef	one
1976-50	W side of middle island, Islas San Benito	Shore	Rock, tide pools, surf grass	six
1946-50	East island, Islas San Benito	Shore	Rock, eel grass, turnable boulders	three

2603-54	1.1 mi NNE of Kelp Pt., Puerto de San Bartolomé	Shore	Rocky ledge, kelp	eight
	Bahía del Tortuga			two
1950-50	Punta Ascunción	Shore	Rock, kelp, tide pools	two
	Off Mexico			nine
Peru				
?380-35	Bahía de la Independencia	Shore	Rock	three valves
SEPTIFER ZETEKI HERTLEIN AND STRONG				
Mexico: Baja California, Pacific coast				
1700-49	8.5 mi E of SE end, Isla de Cedros	42 fms	Mud, with 3" layer of shell	three valves
BS 2180	2 mi E of Punta Entrada, Bahía de la Magdalena	17-18 fms		two valves
BS 2184	1 mi N of Punta Redondo light	18 fms		one valve
Mexico: Gulf of California				
BS 2130	Off Isla Pond	62-85 fms		one valve
BS 270	E of Isla Angel de la Guarda	14 fms		one valve
539-36	Spit, Bahía de los Angeles	1 fm	Sand	one valve
BS 2019	Bahía Salinas, Isla del Carmen	8 fms		many valves
BS 2194	0.75 mi WSW of Punta Perico, Isla del Carmen	95 fms		one valve
BS 2015	Isla San Francisco	19 fms		three valves
650-37	E of Isla San Francisco	47 fms	Coarse sand	one valve
639-37	Canal de San Lorenzo	3-5 fms	Sand, coralline, algae	three valves
BS 2067	Bahía de Los Frailes	10 fms		five valves
BS 2065	Outer Gorda Bank	50 fms		one valve
Dawson 53	Cabeza Ballena	Shore	Granite reef, pools, surf rocks	three, two valves
Mexico				
	Bahía Tenacatita	50 fms		four valves
486-35	Bahía Tenacatita	10 fms	Sand, shell, algae	one
BS 422	Isla Socorro	16 fms		one valve
BS 426	Bahía Sulphur, Isla Clarión	25 fms		one valve
Costa Rica				
BS 324	Bahía de Salinas	6 fms		three valves

Station	Location	Depth	Remarks	Specimens
BS 320	Puerto Parker, off Punta Abajo	30 fms		one valve
466-35	Puerto Parker, opposite Punta Abajo	Small island at entrance	Rock	two
BS 311	Boca de Culebra, Bahía Cocos	3-10 fms		one valve
779-38	Isla de la Nuez, Isla del Coco	30-50 fms	Rock, coral, coralline	three
BS 330	Bahía de Chatham, Isla del Coco	47 fms		many valves
BS 329	Bahía de Chatham, Isla del Coco	40-46 fms		many valves
Panama				
BS 314	Islas Secas	12 fms		several valves
867-38	Islas Secas	Shallow water	Coral	one valve
BS 313	Islas Secas	25 fms		many valves
BS 312	Islas Secas	14 fms		one valve
Colombia				
BS 555	Bahía Octavia	75 fms		two valves
BS 545	Puerto Utría	12 fms		many valves
BS 546b	W of Puerto Utría	35 fms		ten valves
	Off Colombia			three
Galapagos Islands				
97-33	Bahía de Darwin, Isla Genovesa (Tower I.)	Shallow water	Coral	two
96-33	Bahía de Darwin, Isla Genovesa (Tower I.)	Shallow water	Rock	five
BS 439	Bahía de Sulivan, Isla Santiago (James I.)	20 fms		two
	Bahía de Sulivan, Isla Santiago (James I.)			one
BS 462	Bahía de Sulivan, Isla Santiago (James I.)	14 fms		six valves
BS 407	Punta Albemarle, Isla Isabela (Albemarle I.)	13 fms		one valve
BS 428	Punta Albemarle, Isla Isabela (Albemarle I.)	17 fms		one valve
85-33	Isla Seymour (N. Seymour I.)	Shore	Rock	four, one valve
12-32	W of Isla Baltra (S. Seymour I.)			two valves
173-34	Off Isla Baltra (S. Seymour I.)	5 fms	Sand with rock patches	two valves
317-35	Off Gordon Rocks, Isla Santa Cruz (Indefatigable I.)	25-30 fms	Rock	one
170-34	Bahía de Stephens, Isla San Cristóbal (Chatham I.)	32 fms	Fine sand, coralline	seven valves
BS 402	Bahía del Correo, Isla Floreana (Charles I.)	9 fms		one valve

357-35	Bahía de Gardner, Isla Española (Hood I.)	Shallow water	Coral	one
356-35	Bahía de Gardner, Isla Española (Hood I.)	12-15 fms	Rock, tangles	one
Ecuador				
BS 500	Off Isla La Plata	10 fms		two valves
BRACHIDONTES MULTIFORMIS (CARPENTER)				
Mexico: Baja California, Pacific coast				
Dawson 9	Punta Rosarita, Bahía Rosarita	Shore	Rocky headland	one valve
Dawson 14	Miller's Landing, S of Punta Rosarita	Shore	Cobblestone reef	one
Mexico: Gulf of California				
1070-40	Bahía de San Felipe	3 fms	Mud	three valves
1071-40	Bahía de San Felipe	2.5 fms	Sand	many valves
1064-40	Off Punta Willard, Bahía de San Luis Gonzaga	10-20 fms	Mud	five valves
BS 2060	Punta Piaxtla, Sinaloa	8 fms		two valves
Dawson 57	Off Punta San Francisquito, near Guaymas, Sonora			two valves
Dawson 49	Punta Palmilla, near San José del Cabo		Reef, pools	five
Dawson 71	Reef 2 mi N of Mazatlán, Sinaloa	Shore		many
Dawson 70	Mazatlán, Sinaloa			several
Dawson 68	N of Olas Altas light, Mazatlán, Sinaloa	Shore	Rocks, pools	many
Dawson 69	S side of Olas Altas light, Mazatlán, Sinaloa	Shore	Reefs, rocks	many
Dawson 67	N and S side of Playa de las Olas, Mazatlán, Sinaloa	Shore		many
Mexico				
Dawson 85	Barra Navidad, Jalisco	Rocky shore		five
2591-54	Rocas de San Lorenzo, Acapulco, Guerrero	0-2 fms	Rock	several
1552-46	Rocas de San Lorenzo, Hornos, Acapulco, Guerrero			four
2596-54	Bahía de Santa Lucía, Acapulco, Guerrero	1-4 fms	Rock, sand	two
Dawson 123	SE side of bay, Acapulco		Granite outcrops	one
Dawson 94	NW of Salina Cruz, Oaxaca	Rocky headland	Abundant mussels, rocks, tide pools	nine
Dawson 95	S of Salina Cruz, Oaxaca	Headland	Granitic rock	thirteen
Ecuador				
BS 539	Isla Salango	12 fms		five valves, small

Station	Location	Depth	Remarks	Specimens
BRACHIDONTES PURPURATUS (LAMARCK)				
Ecuador				
	Guayaquil			two small
Peru				
369-35	Off Isla de Frontón, near Callao	5 fms	Rock	three valves
384-35	Bahía de la Independencia	5 fms	Rock	two valves
375-35	E of Isla de las Viejas, Bahía de la Independencia	Shore	Sand	three
831-38	Bahía de la Independencia	Shore	Rock	many
380-35	Bahía de la Independencia	Shore	Rock	many
821-38	Bahía de San Nicolas	Shore	Rock	two
BRACHIDONTES PLAYASENSIS (PILSBRY AND LOWE)				
Ecuador				
205-34	Bahía de Santa Elena, off La Libertad	8-12 fms	Sand, shell	one right valve, 8 mm
BRACHIDONTES PUNTARENENSIS (PILSBRY AND LOWE)				
Costa Rica				
466-36	Puerto Parker, opposite Punta Abajo	at entrance Small island	Rock	two
BRACHIDONTES HOUSTONIUS (BARTSCH AND REHDER)				
Galapagos Islands				
343-35	Bahía de Sulivan, Isla Santiago (James I.)	Shore	Rock	one valve
153-34	NE point of Isla Narborough	Shore	Lava rock, tide pools, mangroves	many
88-33	Isla Baltra (S. Seymour I.)	West shore	Rock, sand	one
800-38	Bahía de Cartago, Isla Isabela (Albemarle I.)	North shore	Rock	many
MYTELLA FALCATA (ORBIGNY)				
Mexico				
3-33	Bahía de Petatlán	Shore		two valves
928-39	Laguna de Chacahua, Oaxaca	Lagoon	Mud	many dark colored
Dawson 101	Barra Cahuacán, Chiapas	Shore	Sand, mangroves	many small green colored

MYTELLA GUYANENSIS (LAMARCK)				
Mexico: Gulf of California				
	San Felipe	Intertidal		many
ARCUATULA DEMISSA (DILLWYN)				
California				
Acc. 1255	Upper Newport Bay	Low water level	Mud	two, one 11.4 cm.
MODIOLUS CAPAX (CONRAD)				
California				
1576-46	0.5 mi N of Cayucos, San Luis Obispo Co.		Protected reefs, rocks, pools	one
1575-46	6.7 mi S of Surf (Pedernales Pt.), Santa Barbara Co.		Cliffs, stacks, exposed reefs	one valve
	Portuguese Bend	Shore		one
	San Pedro			one
	Anaheim Landing			one large valve
1217-40	Inside at Pt. Fermin	Shore	Rock wall, loose rock	one
1440-41	Newport Harbor, Corona del Mar	Intertidal	Rocks, sandflats, eel grass	two
1438-41	Newport Harbor, Corona del Mar	Intertidal	Rocks, sandflats	one
1224-41	Newport Channel, Balboa	Shore		four and two valves
1222-41	Newport and Balboa Channel	Shore	Low tide	two
1930-50	Corona del Mar	Shore	Sand, loose and solid rock, eel grass	two
Mexico: Baja California, Pacific coast				
1260-41	Canal de Dewey, opposite Punta Eugenia	21-26 fms	Coralline, rock	one
KG 1	Laguna de Scammon	6-10 fms	Rock	one valve
2603-54	1.1 mi NNE of Kelp Pt., Puerto de San Bartolomé	Shore	Rocky ledge, kelp	two
2605-54	Rocas Sulphur, Puerto de San Bartolomé	Shore	Loose rock	two
1956-50	Punta Abrejos to NE Pt.	Shore	Conglomerate shelf, few tide pools	one
1713-49	Punta Entrada, Bahía de la Magdalena	Shore	Rocky beach, protected and exposed coastline	one
Mexico: Gulf of California				
1051-40	Puerto Refugio, Isla Angel de la Guarda	21 fms	Shell	one
1048-40	Puerto Refugio, Isla Angel de la Guarda	11-22 fms	Shell, sand	one valve
554-36	E of Isla Angel de la Guarda	10 fms	Sand, red algae, scallops	seven

Station	Location	Depth	Remarks	Specimens
1042-40	Isla Turner, S of Isla Tiburón	Shore	Rocky reef	one
1091-40	Puerto San Carlos, Sonora	Shore	Shingle	one valve
1516-46	Ensenada de San Francisco, Sonora		Reefs and pools	one valve
1517-46	Ensenada de San Francisco, Sonora		Reefs and pools	two
617-37	Off Punta Pequeña	24 fms	Sand, kelp	six
1095-40	Puerto Escondido, S of Loreto	1-2 fms		one
670-37	Puerto Escondido, S of Loreto	Shore	Lagoon entrance	one and two valves
591-36	Puerto Escondido, S of Loreto	Shore	Shingle	one
647-37	N of Isla San Francisco	22 fms	Coral	one
512-36	Bahía de Ballenas, Isla Espíritu Santo	Shore	Rock	one
1112-40	Bahía San Gabriél, Isla Espíritu Santo	Shore	Shingle, tide pools at stone pits	two valves
1738-49	Canal de San Lorenzo, Isla Espíritu Santo	13 fms	Coral	two, length 155 mm
607-36	Canal de San Lorenzo	24 fms	Coralline	three
Costa Rica				
465-35	Bahía Playa Blanca	Shore	Shale	three
466-35	Puerto Parker, opposite Punta Abajo	Shore of small island at entrance	Rock	two
Panama				
450-35	Islas Secas	14 fms	Shell, nullipores	one
861-38	Bahía Honda	Shore	Rock	one
Galapagos Islands				
800-38	Bahía de Cartago, Isla Isabela (Albemarle I.)	North shore	Rock	two
Ecuador				
209-34	Off La Puntilla, Bahía de Santa Elena	8-10 fms	Rock, large shells, gorgonids	one
Peru				
380-35	Bahía de la Independencia	Shore	Rock	one, length 14 mm
MODIOLUS FORNICATUS (CARPENTER)				
California				
1669-49	Horseshoe Cove, 2 mi N of Bodega Head, Sonoma Co.		Ocean side	one

1817-49	South Jetty, Bodega Bay, Sonoma Co.			one
	Pacific Grove			three valves
1189-40	Santa Cruz I.	Beach	Low tide, heavy shingle	one
	Portuguese Bend	Shore		one

MODIOLUS RECTUS (CONRAD)

California

	Alamitos Bay, Long Beach			three
	San Diego			two

MODIOLUS EISENI STRONG AND HERTLEIN

Mexico

BS 217	Bahía Tenacatita	50 fms		one and one valve

Costa Rica

253-34	Boca de Culebra	10 fms	Mud, shell	five
116-33	Bahía Cocos, S of Boca de Culebra	2 fms	Sand, shell	one

Panama

863-38	Off Isla Medidor, Bahía Honda	30-50 fms	Rock, sand, mud	one

MODIOLUS NEGLECTUS N. SP.

California

888-38	Near the mouth of the Salinas River, Monterey Bay	10-13 fms	Sand	two
1413-41	2 mi SW of Cardwell Pt., San Miguel I.	34-35 fms	Mud	two
BS 1240	2 mi SW of Cardwell Pt., San Miguel I.	35 fms		four valves
897-38	Off Pt. Santa Barbara	33 fms	Mud	two
1274-41	3.5 mi S of Hueneme	29-30 fms	Shell, mud	two small
1275-41	1.5 mi SE of Pt. Mugu	26-30 fms	Mud	one valve
1141-40	Off El Segundo	28-31 fms	Gray-green sand	two
	SW of Venice			one
Acc. 590	Point Vicente	12 fms		one
Acc. 589	Point Fermin			one, two valves
Acc. 585	Breakwater, Pt. Fermin			two, one valve
	S of Pt. Fermin	25 fms		two small
	San Pedro			one
2168-52	1.8 mi ExS of Los Angeles light	12 fms	Mud	one valve

Station	Location	Depth	Remarks	Specimens
Acc. 547	Long Beach	10-13 fms		one
Acc. 560	Long Beach			many small
Acc. 597	Long Beach			two
Acc. 598	Long Beach light			four
Acc. 579	Seal Beach			two
1169-40	3.25 mi W of Huntington Beach	17-18 fms	Mud, sand	one
2041-51	6.8 mi SE of Pt. Fermin	19 fms	Sand	one
1236-41	6 mi SW of Seal Beach	26-27 fms	Green sand, mud	one valve
1130-40	Off Abalone Pt., Laguna Beach	25-29 fms	Mud	one and three valves
1131-40	Off Abalone Pt., Laguna Beach	54-57 fms	Mud	two
	San Diego			two
Hubbs 45-188	Off Coronado Strand	24-25 fms		one
Mexico: Baja California, Pacific coast				
1716-49	4.75 mi N of Punta Entrada, Bahía de la Magdalena	18 fms	Sand and mud	one
1715-49	5 mi NE of Punta Entrada, Bahía de la Magdalena	13 fms	Sand	one
Mexico: Gulf of California				
1034-40	Outer Gorda Bank	59-64 fms	Coralline, sand	one
MODIOLUS SACCULIFER (BERRY)				
California				
886-38	S of Pillar Pt., Halfmoon Bay	16 fms	Coarse gravel	one
1300-41	1.5 mi NW of Cavern Pt., Santa Cruz I.	54-56 fms	Mud, sand, dead shells	two valves
1189-40	Santa Cruz I.	Beach	Low tide, heavy shingle	one
	Santa Cruz I.			two
1285-41	3 mi SW of Fraser Pt., Santa Cruz I.	15-19 fms	Fine sand, nullipores	one valve
BS 1074	Bechers Bay, N of Santa Rosa I.	14 fms		one valve
1411-41	1.5 mi SW of Judith Rock, San Miguel I.	45-46 fms	Soft sand	one small
990-39	San Miguel Passage	37-39 fms	Shale, gray sand, mud	one
1294-41	0.5 mi S of Gull I., off Santa Cruz I.	34-41 fms	Sand, shell	one
1280-41	2.5 mi E of South Point, Santa Rosa I.	15-21 fms	Shell, red algae	two valves, subfossil

1283-41	2.25 mi E of South Point, Santa Rosa I.	23-28 fms	Gravel, sand	three valves, subfossil
	Venice			three valves
Acc. 589	Pt. Fermin, San Pedro			one
Acc. 169	Pt. Fermin, San Pedro			one
2052-51	2.7 mi SSE of Long Beach Light	13-14 fms	Sand, mud, kelp, red algae	one valve
1160-40	11.5 mi SE of Long Beach	32-52 fms	Mud, sand, dead shells	one
1130-40	Off Abalone Pt., Laguna Beach	25-29 fms	Mud	two valves
2246-53	0.8 mi SE of south light, Santa Barbara I.	19 fms	Coarse black mud, sand	nine valves
	Isthmus Cove, Catalina I.			four
1186-40	Off Ship Rock, Catalina I.	7-16 fms	Sand, mud, algae	seven
BS 1282	White Cove, Catalina I.	14 fms		two valves
1651-48	0.5 mi off Empire Landing, Catalina I.	27 fms	Sandy mud, worm tubes, dead shell	two valves
1375-41	1 mi E of Empire Landing, Catalina I.	18 fms	Worm tubes, kelp	four
Acc. 481	Catalina I.			one
Acc. 413	Catalina I.			seven
Acc. 353	Catalina I.			one small
Acc. 342	Catalina I.			two small
Acc. 600	Off Catalina I.	30 fms		many small
1905-49	White Cove, Catalina I.	14 fms	Kelp, worm tubes	one
1902-49	Off Little Harbor, Catalina I.	15-16 fms	Kelp	two valves
	Blackbuoy Anchorage, Catalina I.			seven small
Acc. 662	Light, Catalina I.			two
1238-41	Off Wilson Cove, San Clemente I.	14-16 fms	Kelp, gray sand	one

MODIOLUS AMERICANUS (LEACH)
Mexico: Baja California, Pacific coast

1261-41	4 mi N of Canal de Dewey	24-25 fms	Gray-green sand	one subfossil valve
1787-49	0.5 mi SE of Punta Hughes, Bahía de Santa María	5-18 fms		one

Ecuador

211-34	Isla La Plata	Shore	Rock	one small, dead

AMYGDALUM PALLIDULUM (DALL)
California

1274-41	3.5 mi S of Hueneme	29-30 fms	Shell, mud	one

Station	Location	Depth	Remarks	Specimens
1300-41	1.5 mi NW of Cavern Pt., Santa Cruz I.	54-56 fms	Mud, sand, dead shell	five
1303-41	0.5 mi N of Platt Pt., Santa Cruz I.	36-47 fms	Dead shells	one
1267-41	3 mi NW of Anacapa I. light	47-52 fms	Gray-green sand	eight
990-39	San Miguel Passage	37-39 fms	Shale, gray sand, mud	one large
1396-41	2.5 mi SE of Bennett Pt., San Miguel I.	57-62 fms	Crinoids	many
BS 1234	2.5 mi SE of Bennett Pt., San Miguel I.	57 fms		many
BS 1070	Off Santa Cruz I.	127 fms		seven
1288-41	5 mi S of Fraser Pt., Santa Cruz I.	74-103 fms	Green mud	nine
1191-40	S side of Santa Cruz I.	37-39 fms	Sand, shell	many large
1194-40	Off Gull I., south side of Santa Cruz I.	39-43 fms	Gray sand, mud	twelve
1294-41	0.5 mi S of Gull I., off Santa Cruz I.	34-41 fms	Sand, shell	two
1289-41	2.6 mi E of East Pt., Santa Rosa I.	47-49 fms	Green mud	many
BS 1158	2.6 mi E of East Pt., Santa Rosa I.	49 fms		one
1192-40	Off Bowen Pt., Santa Cruz I.	58-90 fms	Sand, broken shells	one
1435-41	1.5 mi SW of Gull I., off Santa Cruz I.	48 fms	Mud, sponge	six
BS 1230	3.6 mi off East Pt., Santa Rosa I.	55 fms		four
1388-41	3.6 mi off East Pt., Santa Rosa I.	54-55 fms	Green mud, crinoids	two and one valve
1387-41	4.5 mi SE of East Pt., Santa Rosa I.	52 fms	Green, sandy mud	two and two valves
BS 1229	4.5 mi SE of East Pt., Santa Rosa I.	52 fms		one and two valves
1390-41	4.5 mi SW by 0.5 mi W of East Pt., Santa Rosa I.	43-45 fms	Green mud	many
BS 1231	4.5 mi SW by 0.5 mi W of East Pt., Santa Rosa I.	45 fms		many
Burch 4135	El Segundo			one small
BS 1135	6 mi SW of Seal Beach	26 fms		six
1222-41	Newport and Balboa Channel	Shore	Low tide	one
1129-40	Off Newport Beach	40-50 fms	Mud	two large
981-39	5.5 mi N of Santa Barbara I.	76-87 fms	Gray sand, sponges	two valves
BS 1130	10 mi S of San Pedro breakwater	81 fms		many
1130-40	Off Abalone Pt., Laguna Beach	25-29 fms	Mud	one
1178-40	Off Eagle Bank, N of Catalina I.	40-43 fms	Gray sand	three
1183-40	Off Howland's Landing, Catalina I.	130-160 fms	Mud	six
1184-40	W end of Catalina I.	46-55 fms	Gray sand	three
1185-40	W end of Catalina I.	50-110 fms	Green sand, broken shell	one
1398-41	4 mi E of Landing, Santa Barbara I.	40 fms	Sand	one
1181-40	Off Howland's Landing, Catalina I.	47-64 fms	Broken shells, brachiopods	ten

BS 1220	0.75 mi E of Empire Landing, Catalina I.	57 fms		one valve
1000-39	Off Long Pt., Catalina I.	90-101 fms	Mud	two
1384-41	0.5 mi NE of Long Pt., Catalina I.	108-109 fms	Green, sandy mud	many
1002-39	Off Long Pt., Catalina I.	50 fms	Mud, sand	six
1316-41	1 mi S of Ben Weston Pt., Catalina I.	45-49 fms	Mud, sand, gravel	one
1355-41	4 mi E of Church Rock, Catalina I.	106-110 fms	Gray sand	one
1028-39	S of SE end of Catalina I.	83-125 fms	Mud, rock	four
1125-40	Off San Nicolas I.	97-104 fms	Green sand	one
1321-41	2 mi W of Church Rock, Catalina I.	45-53 fms	Mud, sand	one, six valves
1220-40	1.5 mi off Dutch Harbor, San Nicolas I.	63-83 fms	Gray sand, mud, dead shell	four
1026-39	NW of San Clemente I.	118-210 fms	Sponges, mud	one, one valve
913-39	Off Pyramid Cove, San Clemente I.	35-46 fms	Fine gray sand	one
1012-39	S of Pyramid Cove, San Clemente I.	55-69 fms	Sand, shell	one large
BS 1196	9.5 mi NNW of buoy, Cortes Bank	110 fms		two valves
Mexico: Baja California, Pacific coast				
1245-41	4 mi N of Islas de Todos Santos	41 fms	Shell, mud, gray sand	one and two valves
BS 2169	2 mi SE of Isla de Cedros light	55 fms		two valves
1010-39	Off Islas San Benito	71-86 fms	Fine green sand	one large
1251-41	5.5 mi S of Islas San Benito	66-81 fms	Fine green and gray sand	one
1256-41	8.5 mi S of Isla de Cedros	52-55 fms	Fine gray-green mud, small shells	one large
BS 2166	8.5 mi S of Canal de Dewey	49 fms		two valves
Colombia				
BS 509	Off coast of Colombia, SW of Isla Gorgona (1° 02′ 30″ N, 81° 12′ W)	18 fms		many small
AMYGDALUM AMERICANUM N. SP.				
Mexico				
964-39	Bahía Tenacatita	2-8 fms	Mud	one
123-33	Bahía Tenacatita	Shore		one
259-34	El Bufadero	15-20 fms	Sand, gravel, mud	one
Costa Rica				
461-35	Bahía Playa Blanca	15 fms	Mud, sand, algae	one
253-34	Boca de Culebra	10 fms	Mud, shell	two valves
257-34	Bahía Cocos, off Boca de Culebra	10 fms	Sand, shell	one

Station	Location	Depth	Remarks	Specimens
Colombia				
409-34	Off North Point, Isla Gorgona	20 fms	Nullipores	one
LIOBERUS SALVADORICUS (HERTLEIN AND STRONG)				
Costa Rica				
253-34	Boca de Culebra	10 fms	Mud, shell	one small
116-33	Bahía Cocos, S of Boca de Culebra	2 fms	Sand, shell	one
MUSCULUS OLIVACEUS DALL				
Oregon				
1498-42	35 mi W of Depoe Bay	60-74 fms	From a water-logged maple stump full of holes	five
GREGARIELLA COARCTATA (CARPENTER)				
Mexico: Baja California, Pacific coast				
KG 5	Laguna de Scammon	5-9 fms	Shell	one
Mexico: Gulf of California				
638-37	Bahía San Gabriél, Isla Espíritu Santo	Shallow water	Coral	one
Panama				
Acc. 1097	Isla Taboga	2-5 fms		one
GREGARIELLA CHENUI (RECLUZ)				
California				
1300-41	1.5 mi NW of Cavern Pt., Santa Cruz I.	54-56 fms	Mud, sand, dead shell	one valve
BS 1050	Off Pt. Bennett, San Miguel I.	34 fms		one valve
1295-41	1 mi SE of Smugglers Cove, Santa Cruz I.	15-21 fms	Coralline sand, pebbles	two valves
1190-40	Anacapa Passage	15-50 fms	Sand, gravel	three valves
1191-40	S side of Santa Cruz I.	37-39 fms	Sand, shell	three valves
1143-40	Off Portuguese Pt.	16-20 fms	Gray sand, sea weed	one valve
BS 1255	1.5 mi off White Pt.	30 fms		two valves
1187-40	Off Bird Rock, Catalina I.	31-40 fms	Rock, coarse shell, kelp	five
1186-40	Off Ship Rock, Catalina I.	7-16 fms	Sand, mud, algae	one and two valves
BS 1254	Anchorage, White Cove, Catalina I.	17 fms		one valve
BS 1257	0.5 mi off Empire Landing, Catalina I.	27 fms		ten valves
BS 1216	Off Goat Harbor, Catalina I.	30 fms		one valve
BS 1249	Long Pt. to Willow Cove, Catalina I.	45 fms		two

1406-41	N side, White Cove, Catalina I.	Shore	On rocks near dock; kelp	two valves
1363-41	White Cove, Catalina I.	Shore		one small
1399-41	2 mi SE of Long Pt., Catalina I.	47 fms		one valve
	Blackbuoy Anchorage, N side of Catalina I.			one
BS 1280	2 mi N of Cortes Bank	120-137 fms		two valves
Mexico: Baja California, Pacific coast				
BS 2174	6.75 mi NW of Isla San Martin	37 fms		one valve
BS 2169	2 mi SE of Isla de Cedros light	55 fms		one valve
BS 2176	Cove 1.5 mi S of Isla de Cedros light	10-20 fms		seven valves
BS 2160	1 mi S of Islas San Benito	44 fms		three valves
BS 2179	South Bay, Isla de Cedros	16 fms		many valves
BS 2177	8 mi SE of north end of Isla de Cedros	60 fms		one valve
BS 2165	3 mi NW of Isla Natividad	30 fms		two valves
1261-41	4 mi N of Canal de Dewey	24-25 fms	Gray-green sand	four valves
BS 2168	4 mi N of Canal de Dewey	24 fms		four valves
BS 2178	3.75 mi NNW of Punta Eugenia	20 fms		many valves
BS 2167	Canal de Dewey, Punta Eugenia	23 fms		four valves
1030-40	Off Bahía del Tortuga	26-31 fms	Gray sand, mud	four valves
BS 2180	2 mi E of Punta Entrada, Bahía de la Magdalena	17-18 fms		many valves
BS 2184	1 mi N of Punta Redondo light	18 fms		four valves
Mexico: Gulf of California				
BS 2045	Isla San Jorge	9 fms		one valve
BS 2037	N of Isla Angel de la Guarda	50-75 fms		nine valves
BS 2035	N of Isla Angel de la Guarda	60 fms		one valve
BS 2033	Isla Angel de la Guarda	46 fms		one valve
BS 2051	Isla San Pedro Nolasco	82 fms		one valve
BS 286	Isla San Pedro Nolasco	48 fms		two valves
BS 2029	Isla Tortuga	45 fms		two valves
584-36	Bahía Concepción	West beach	Sponge, sand	one valve
BS 2024	Off Isla Ildefonso	55 fms		two valves
BS 2142	Bahía de Agua Verde	20 fms		two valves
Mexico				
BS 217	Bahía Tenacatita	50 fms		three valves

Station	Location	Depth	Remarks	Specimens
Panama				
BS 333	Islas Secas	12 fms		one valve
BS 332	Bahía Honda, off North I.	30-50 fms		six valves
Colombia				
BS 554	Bahía Octavia	45 fms		one valve
Galapagos Islands				
BS 418	Bahía de Darwin, Isla Genovesa (Tower I.)	17 fms		one valve
346-35	Between Isla Baltra (S. Seymour I.) and Islas Daphne	55 fms	Mud, shell	one valve
187-34	Bahía de Cartago, Isla Isabela (Albemarle I.)	8-10 fms	Sand, with rock patches	one valve
BS 452	Bahía del Correa, Isla Floreana (Charles I.)	65 fms		two valves
BS 410	Ensenada Tagus, Isla Isabela (Albemarle I.)	9 fms		six valves
BS 465	Black Beach, Isla Floreana (Charles I.)	15 fms		two valves
BS 454	Isla Española (Hood I.)	30 fms		two valves
Peru				
380-35	Bahía de la Independencia	Shore	Rock	two valves
CRENELLA DIVARICATA (ORBIGNY)				
California				
BS 1240	2 mi SW of Cardwell Pt., San Miguel I.	35 fms		four valves
BS 1167	0.5 mi NE of Platt Harbor	31 fms		one valve
BS 1239	1.5 mi S of Crook Pt., San Miguel I.	41 fms		one valve
BS 1231	4.5 mi SW by 0.5 mi W of east point, Santa Rosa I.	45 fms		one valve
Burch 4135	El Segundo			many valves
BS 1252a	1.3 mi NNE of Long Pt., Catalina I.	109 fms		one valve
BS 1073	Off Catalina I.	50 fms		one
BS 1198	5 mi SE of Church Rock, Catalina I.	118 fms		one valve
BS 1138	Off Wilson Cove, San Clemente I.	52 fms		one valve
BS 1185	0.5 mi W of Castle Rock, San Clemente I.	37 fms		one valve
BS 1054	Pyramid Cove, San Clemente I.	78-110 fms		four valves
Mexico: Baja California, Pacific coast				
BS 228	Ensenada Melpomene, Isla de Guadelupe	17 fms		three valves

BS 2070	Isla de Guadelupe	250 fms		one valve
BS 2173	7.25 mi S of Cabo Colnett	31 fms		one valve
BS 2174	6.75 mi NW of Isla San Martín	37 fms		two valves
BS 2069	Isla de Cedros	10 fms		four valves
BS 2179	Isla de Cedros, south bay	16 fms		fifty-two valves
1261-41	4 mi N of Canal de Dewey	24-25 fms	Gray-green sand	twenty valves
BS 2178	3.75 mi NNW of Punta Eugenia	20 fms		many valves
BS 2168	4 mi N of Canal de Dewey	24 fms		nine valves
1030-40	Bahía del Tortuga	26-31 fms	Gray sand and mud	forty-two valves
BS 2181	5 mi NE of Punta Entrada, Bahía de la Magdalena	13 fms		four valves
BS 2184	1 mi N of Punta Redonodo light	18 fms		two valves
Mexico: Gulf of California				
1070-40	Bahía de San Felipe	3 fms	Mud	two valves
1071-40	Bahía de San Felipe	2.5 fms	Sand	two valves
BS 2046	Off Isla San Jorge	14 fms		three valves
BS 2045	Isla San Jorge	9 fms		four valves
1061-40	Off Punta Willard, Bahía de San Luis Gonzaga	30-40 fms	Mud	nineteen valves
1064-40	Off Punta Willard, Bahía de San Luis Gonzaga	10-20 fms	Mud	thirteen valves
BS 2036	N of Isla Angel de la Guarda	90 fms		one valve
BS 2037	N of Isla Angel de la Guarda	50-75 fms		seven valves
BS 2035	N of Isla Angel de la Guarda	60 fms		eighteen valves
BS 2034	Anchorage, Punta Refugio, Isla Angel de la Guarda	15 fms		twenty-nine valves
BS 2049	Isla Patos	12 fms		five valves
BS 2032	Bahía de los Angeles	15 fms		twenty-three valves
BS 2030	Entrance, Bahía de los Angeles	30 fms		one valve
BS 2052	Ensenada de San Francisco, Sonora			three valves
BS 286	Isla San Pedro Nolasco	48 fms		one valve
BS 2024	Off Isla Ildefonso	55 fms		one valve
BS 2021	Punta Púlpito	15 fms		one valve
BS 2188	Isla del Carmen, Bahía Salinas	25 fms		thirty valves
BS 2019	Isla del Carmen, Bahía Salinas	8 fms		two valves
BS 2194	0.75 mi WSW of Punta Perico, Isla del Carmen	95 fms		many valves

Station	Location	Depth	Remarks	Specimens
593-36	Puerto Escondido, S of Loreto	5 fms	Mud, shell	many valves
BS 2017	Puerto Escondido, S of Loreto	20 fms		fourteen valves
BS 2018	Off Puerto Escondido	34 fms		seven valves
BS 2196	Bahía San Gabriél, Isla Espíritu Santo	6 fms		one valve
BS 2012	Bahía San Gabriél, Isla Espíritu Santo	24 fms		eight valves
BS 2067	Bahía de Los Frailes	10 fms		six valves
BS 2062	Isla Isabel	18 fms		six valves
Mexico				
BS 2073	Off Black Rocks, near Cabo Corrientes, Jalisco	20 fms		one valve
BS 2086	Bahía Tenacatita	8-15 fms		eight valves
BS 217	Bahía Tenacatita	50 fms		ten valves
BS 214	Near Los Frailes Blancos	100 fms		two pieces
BS 2075	Laguna de Chacahua, Oaxaca	41 fms		one valve
BS 2076	Laguna de Chacahua, Oaxaca	51 fms		three valves
Guatemala				
930-39	Off San José light	12-13 fms	Fine black sand	one large valve
BS 325	Off San José	20 fms		seven valves
Costa Rica				
BS 324	Bahía de Salinas	6 fms		several valves
BS 323	Bahía de Salinas	8 fms		five valves
BS 320	Puerto Parker, off Punta Abajo	30 fms		several valves
BS 336	Puerto Parker, off Punta Abajo	15 fms		three valves
BS 319	Puerto Parker, off Punta Abajo	5 fms		eight valves
BS 309	Boca de Culebra	15 fms		several valves
253-34	Boca de Culebra	10 fms	Mud, shell	one valve
116-33	Bahía Cocos, S of Boca de Culebra	2 fms	Sand, shell	many
BS 339	Golfo Dulce	48 fms		several valves
BS 328	Bahía de Chatham, Isla del Coco	14 fms		one valve
Panama				
BS 342	Islas Secas	25-26 fms		several valves
BS 307	Islas Secas	40-80 fms		ten valves
BS 312	Islas Secas	14 fms		several valves
BS 340	Off Islas Ladrones	54 fms		five valves

BS 332	Bahía Honda, off North I.	30-50 fms		one valve
BS 556	Puerto Piñas	12 fms		many small valves
BS 557	Puerto Piñas	29 fms		one valve
BS 310	Off Isla Jicarita	24 fms		three valves
Colombia				
BS 555	Bahía Octavia	75 fms		one valve
BS 546b	W side of Puerto Utría	35 fms		one valve
BS 514	Bahía Cabita, Cabo Corrientes	16 fms		one valve
BS 584	N of Isla Gorgona	32 fms		nine valves
BS 541	Isla Gorgona	35 fms		two valves
Galapagos Islands				
317-35	Off Rocas Gordon, Isla Santa Cruz (Indefatigable I.)	25-30 fms	Rock	one small valve
BS 483	Bahía de Academy, Isla Santa Cruz (Indefatigable I.)	10-20 fms		five valves
Ecuador				
BS 518	Isla La Plata	45-55 fms		one valve
BS 539	Isla Salango	12 fms		five valves
BS 507	Bahía de Santa Elena, off Salinas	8-12 fms		one valve
BS 504	Bahía de Santa Elena, off Salinas	25 fms		one valve
BS 502	Bahía de Santa Elena, off Salinas	15 fms		two valves
BS 501	Bahía de Santa Elena, off beach	4 fms		many valves
Peru				
BS 578	Bahía de Sechura	10 fms		one valve
BS 522	Near Rocas de San Lorenzo, Callao	25 fms		one valve
CRENELLA DECUSSATA (MONTAGU)				
California				
BS 1240	2 mi SW of Cardwell Pt., San Miguel I.	48 fms		two and nine valves
1413-41	2 mi SW of Cardwell Pt., San Miguel I.	34-35 fms	Mud	one valve
1436-41	2.75 mi N of West Pt., Santa Cruz I.	55 fms	Mud, shell	five valves
1298-41	1 mi N of San Pedro Pt., Santa Cruz I.	45-46 fms	Sand, broken shells	one valve
BS 1250	3 mi E of South Point, Santa Rosa I.	17 fms		one valve
BS 1012	Torney's Cove, Santa Cruz I.			two valves
BS 1074	Bechers Bay, N of Santa Rosa I.	14 fms		one

Station	Location	Depth	Remarks	Specimens
BS 1023	Santa Rosa I.	16 fms		six and one valve
BS 1050	Off Pt. Bennett, San Miguel I.	34 fms		two valves
BS 1238	1 mi S of Pt. Bennett, San Miguel I.	48 fms		two and nine valves
BS 1051	Between Crook and Cardwell Pts., San Miguel I.	12-19 fms		two valves
BS 1155	3 mi S of Fraser Pt., Santa Cruz I.	24 fms		one valve
995-39	Bechers Bay, Santa Rosa I.	10 fms	Sand, coralline	one
1191-40	S side of Santa Cruz I.	37-39 fms	Sand, shell	two valves
1387-41	4.5 mi SE of East Point, Santa Rosa I.	52 fms	Green, sandy mud	two valves
BS 1229	4.5 mi SE of East Point, Santa Rosa I.	52 fms		sixteen valves
BS 1153	2.5 mi E of South Point, Santa Rosa I.	23 fms		one and one valve
BS 1231	4.5 mi SW by 0.5 mi W of East Point, Santa Rosa I.	45 fms		five valves
Burch 4135	El Segundo			several and valves
BS 1094	Off Redondo Beach	18-45 fms		one valve
BS 1093	Off Redondo Beach	16-32 fms		three valves
1143-40	Off Portuguese Pt.	16-20 fms	Gray sand, sea weed	thirteen valves
BS 1255	1.5 mi off White's Pt.	30 fms		three valves
2741-54	9.3 mi E of Los Angeles breakwater light	5 fms	Red sand, shell	eight
BS 1227	16.5 mi SSE of East Point, Santa Rosa Island	75 fms		three valves
BS 91	Santa Barbara I.			one valve
BS 1114	Off Eagle Bank, N of Catalina I.	40 fms		two and four valves
BS 1112	W of Santa Barbara I.	150 fms		two valves
BS 1115	Isthmus Cove, Catalina I.	14 fms		one and two valves
BS 1254	White Cove Anchorage, Catalina I.	17 fms		seven valves
BS 1221	Off White Cove, Catalina I.	105 fms		two and three valves
BS 1216	Off Goat Harbor, Catalina I.	30 fms		nine valves
BS 1111	Middle of San Pedro Channel	67 fms		six valves
BS 1017	Avalon Harbor, Catalina I.			one valve
Acc. 600	Off Catalina I.	30 fms		one
BS 1249	Long Pt. to Willow Cove, Catalina I.	45 fms		one
1399-41	2 mi SE of Long Pt., Catalina I.	47 fms		one valve
BS 1177	1 mi SW of Ben Weston Pt., Catalina I.	45 fms		one valve
BS 1087	E side of San Nicolas I.	97 fms		four valves
BS 1086	E side of San Nicolas I.	30 fms		one valve

BS 1244	2.5 mi SE of Seal Rocks, Catalina I.	91 fms		one valve
BS 1084	5 mi of SE of Catalina I.	144 fms		two
BS 1137	Off Wilson Cove, San Clemente I.	14 fms		five valves
BS 1003	Northwest Harbor, San Clemente I.	13 fms		eight
BS 1185	0.5 mi W of Castle Rock, San Clemente I.	37 fms		two valves
BS 1002	Northwest Anchorage, San Clemente I.	20 fms		four and nine valves
BS 1058	Pyramid Cove, San Clemente I.	29 fms		twenty small
BS 1280	2 mi N of Cortes Bank	120-137 fms		one valve
BS 1194	4.5 mi NNW of buoy, Cortes Bank	60 fms		one valve
BS 1188	4 mi NE of buoy, Cortes Bank	60 fms		two valves
BS 1189	3 mi E of buoy, Cortes Bank	51 fms		three valves
Mexico: Baja California, Pacific coast				
BS 2160	1 mi S of Islas San Benito	44 fms		many valves
BS 2166	8.5 mi S of Canal de Dewey	49 fms		seven valves
SOLAMEN COLUMBIANUM (DALL)				
California				
1413-41	2 mi SW of Cardwell Pt., San Miguel I.	34-35 fms	Mud	one valve
BS 1240	2 mi SW of Cardwell Pt., San Miguel I.	35 fms		thirteen valves
1274-41	3.5 mi S of Hueneme	29-30 fms	Shell, mud	one
1300-41	1.5 mi NW of Cavern Pt., Santa Cruz I.	54-56 fms	Mud, sand, dead shells	one and six valves
1275-41	1.5 mi SE of Point Mugu	26-30 fms	Mud	two valves
990-39	San Miguel Passage	37-39 fms	Shale, gray sand, mud	seven and one valve
1191-40	S side of Santa Cruz I.	37-39 fms	Sand, shell	eight
1289-41	2.6 mi E of East Point, Santa Rosa I.	47-49 fms	Green mud	two
992-39	Off Santa Rosa I.	130-230 fms	Gravel, mud	five large
1390-41	4.5 mi SW by 0.5 mi W of East Point, Santa Rosa I.	43-45 fms	Green mud	one
BS 1231	4.5 mi SW by 0.5 mi W of East Point, Santa Rosa I.	45 fms		one valve
Burch 4135	El Segundo			one valve
Burch 4029	Bluff Cove, Anaheim Slough			one
Acc. 589	Point Fermin			one
Acc. 584	Point Fermin breakwater			one
1202-40	Off Point Fermin	16-18 fms	Gray mud	one
2061-51	10.5 mi NW of north light, Santa Barbara I.	150-165 fms	Mud	four

Station	Location	Depth	Remarks	Specimens
1236-41	6 mi SW of Seal Beach	26-27 fms	Green sand, mud	four and many valves
1130-40	Off Abalone Pt., Laguna Beach	25-29 fms	Mud	four and four valves
1201-40	Off W end of Catalina I.	134-150 fms	Green mud	four
1183-40	Off Howland's Landing, Catalina I.	130-160 fms	Mud	one valve
BS 1257	0.5 mi off Empire Landing, Catalina I.	27 fms		one valve
BS 1216	Off Goat Harbor, Catalina I.	30 fms		three valves
1384-41	0.5 mi NE of Long Pt., Catalina I.	108-109 fms	Green, sandy mud	one
1157-40	3.25 mi E of Long Pt., Catalina I.	285-290 fms	Mud	one
BS 1177	1 mi SW of Ben Weston Pt., Catalina I.	45 fms		two valves
1352-41	6 mi E of Church Rock, Catalina I.	170-192 fms	Gray-green sand	one
1220-40	1.5 mi off Dutch Harbor, San Nicolas I.	63-83 fms	Gray sand, mud, dead shells	one and one valve
1026-39	NW of San Clemente I.	118-210 fms	Mud	four
1022-39	Off Pyramid Cove, San Clemente I.	150-170 fms	Green mud	five
1240-41	9 mi off San Diego	78-81 fms	Green sand, pebbles	one and one valve
Mexico: Baja California, Pacific coast				
BS 2160	1 mi S of Islas San Benito	44 fms		three valves
1253-41	8 mi W of Isla de Cedros	64-65 fms	Gravel, loose rock	one
1948-50	8 mi WSW of Isla de Cedros	60-63 fms	Mud, fine sand	one large living but broken, length at least 22 mm
BS 2005	San Jaime Bank, off Cabo San Lucas	75 fms		three valves
Mexico: Gulf of California				
BS 2036	N of Isla Angel de la Guarda	90 fms		one valve
Mexico				
BS 223	Bahía Sulphur, Isla Clarión	53 fms		one valve
DACRYDIUM (QUENDREDA) ELEGANTULUM N. SP.				
California				
1132-40	Off Redondo Beach	43-85 fms	Mud	one valve
BS 1000	Off San Pedro			eleven valves
BS 1113	N of Santa Barbara I.	40 fms		two valves
BS 1084	5 mi SE of Catalina I.	144 fms		two valves
BS 1192	Wilson Cove, San Clemente I.	25 fms		one valve

BS 1185	0.5 mi W of Castle Rock, San Clemente I.	37 fms		six valves
BS 1054	San Clemente I., Pyramid Cove	78-110 fms		one valve
Mexico: Baja California, Pacific coast				
BS 2160	1 mi S of Islas San Benito	44 fms		one valve
BS 2005	San Jaime Bank, off Cabo San Lucas	75 fms		one valve
Mexico: Gulf of California				
BS 2023	Off Isla Ildefonso	50 fms		one valve
BS 2194	0.75 mi WSW of Punta Perico, Isla del Carmen	95 fms		ten valves
BS 2063	Outer Gorda Bank	56 fms		one valve
BS 2065	Outer Gorda Bank	50 fms		one valve
BS 2064	Outer Gorda Bank	82 fms		one valve
Galapagos Islands				
182-34	Off Bahía de James, Isla Santiago (James I.)	30 fms	Coarse sand	one living
BS 461	Ensenada Tagus, Isla Isabela (Albemarle I.)	80 fms		thirty-one valves
BS 447	Bahía de Cartago, Isla Isabela (Albemarle I.)	32 fms		eight valves
BS 484	Isla Santa Fé (Barrington I.)	52 fms		two valves
BS 455	Bahía de Cartago, Isla Isabela (Albemarle I.)	65 fms		five valves
BS 452	Bahía del Correa, Isla Floreana (Charles I.)	70 fms		twenty valves
BS 488	Off Isla Española (Hood I.)	160 fms		one valve
201-34	Off Bahía de Gardner, Isla Española (Hood I.)	25-35 fms	Rock	one small living
BS 453	Bahía de Gardner, Isla Española (Hood I.)	35 fms		thirty valves
BS 473	Off Isla Española (Hood I.)	75 fms		five valves
ADULA FALCATA (GOULD)				
California				
	Point Arena		On wide, flat reef	two
	Point Fermin			one
Peru				
380-35	Bahía de la Independencia (Label wrong?)	Shore	Rock	one large broken, one small

Station	Location	Depth	Remarks	Specimens
ADULA CALIFORNIENSIS (PHILIPPI)				
Oregon				
1479-42	Boiler Bay, N of Depoe Bay	Intertidal	Flat rocks, large boulders, much algae	six
1463-42	Old submerged jetty, Fossil Pt., Coos Bay	Intertidal	Loose rock covered with dark brown kelp	one
1476-42	Old submerged jetty, Coos Bay	Intertidal	Loose rocks, tide pools, kelp holdfasts	eight
1501-42	Old breakwater jetty, Fossil Pt., Coos Bay	Intertidal	Loose rocks, shale, algae beds	twenty-one
1466-42	N side, Sunset Bay, Coos Co.	Intertidal	Mussel reefs, sandstone ledges, tide pools	three
1464-42	S side, Sunset Bay, Coos Co.	Intertidal	Loose rocks, sand, kelp holdfasts, tide pools	two
1490-42	Cape Arago light, reef and bight, Coos Co.	Intertidal	Loose rock, shale ledges, heavy kelp	nine
1493-42	North Beach, Cape Arago State Park, Coos Co.	Intertidal	Reefs, tide pools, loose rocks	nine
1487-42	Middle Bay, Cape Arago State Park, Coos Co.	Intertidal	Shore, loose rocks, tide pools, kelp	eight
1468-42	Middle Bay, Cape Arago State Park, Coos Co.	Intertidal	Rocks, kelp, tide pools	twenty-two
California				
1804-49	Campbell's Cove, Bodega Lagoon, Sonoma Co.			four
1794-49	Campbell's Cove, Bodega Lagoon, Sonoma Co.			one
1607-48	Dillon Beach, Marin Co.		Exposed rocky coast, sand	one
ADULA DIEGENSIS (DALL)				
Oregon				
1484-42	W of Fossil Pt., Coos Bay	4-6 fms	Fine sand	two
1474-42	Charleston, N of bridge, mudflats on east side	Intertidal	Mud and sand flats	one
California				
M 67-49	Bodega Lagoon, Sonoma Co.			many
M 70-49	Bodega Lagoon, Sonoma Co.		Clam beds	one
1794-49	Campbell's Cove, Bodega Lagoon, Sonoma Co.			one, length 22 mm
1815-49	North Jetty, Bodega Bay, Sonoma Co.			one
1817-49	South Jetty, Bodega Bay, Sonoma Co.			one
1607-48	Dillon Beach, Marin Co.		Exposed rocky coast, sand	three small

1608-48	Tomales Pt., Marin Co.		Bluff	three
LITHOPHAGA (STUMPIELLA) CALYCULATA (CARPENTER)				
Mexico				
130-34	Bahía Braithwaite, Isla Socorro	Shore	Rock, large shingle, tide pools	one
141-34	Bahía Sulphur, Isla Clarión	Shore	Shingle	one
Galapagos Islands				
170-34	Bahía de Stephens, Isla San Cristóbal (Chatham I.)	32 fms	Fine sand, corallines	one
LITHOPHAGA (DIBERUS) CANALIFERA (HANLEY)				
Ecuador				
401-35	Bahía de Manta	1 fm	Sand	two
LITHOPHAGA (DIBERUS) PLUMULA (HANLEY)				
Mexico: Gulf of California				
716-37	Off Punta Willard, Bahía de San Luis Gonzaga	2-3 fms	Sand	one
638-37	Bahía de San Gabriél, Isla Espíritu Santo	Shallow water	Coral	two
973-39	Isla Isabel	Shore	Rock	one
Mexico				
2600-54	Cove W of Squall Pt., Bahía Tenacatita	0-4 fms	Rock	one
265-34	Bahía de Petatlán	5-10 fms	Hard sand, shell	one, and pieces of one
Costa Rica				
465-35	Bahía Playa Blanca	Shore	Shale	one
460-35	Bahía Playa Blanca	3-5 fms	Sand, shells	nine
473-35	Puerto Parker, off Punta Abajo	Shallow water	Coral	seven
256-34	S of Punta Mala, Boca de Culebra	Shore	Rock	one
258-34	Off Bahía Cocos	Shallow water	Coral	eleven
Panama				
867-38	Islas Secas	Shallow water	Coral	two
447-35	Islas Secas	Shallow water	Coral	two
446-35	Islas Secas	Shore	Rock	one

Station	Location	Depth	Remarks	Specimens
450-35	Islas Secas	14 fms	Shell, nullipores	one
948-39	Off Isla Medidor, Bahía Honda	30-35 fms	Rock, mud, coralline	one
114-33	Bahía Honda	Shallow water	Coral	two small
437-35	Puerto Piñas	Shallow water	Coral	one
444-35	Puerto Piñas	2-4 fms	Coral	nine, pieces
Colombia				
435-35	Bahía Octavia	Shallow water	Coral	nineteen
859-38	Puerto Utría	Shallow water	Coral	eight
419-35	Puerto Utría	Shallow water	Coral	two
414-35	Puerto Utría	3 fms	*Pocillopora* coral	three
413-35	Puerto Utría	Shore	Rock	two
229-34	Bahía Cabita, Cabo Corrientes	Shore near stream	Sand	nine
404-35	Off Isla Gorgona	3 fms	Rock	one small
222-34	Isla Gorgona	Shallow water	Coral	three
411-35	Isla Gorgona	Shallow water	*Pocillopora* coral	thirteen
412-35	Isla Gorgona	Shallow water	*Pavona* coral	one
Galapagos Islands				
357-35	Bahía de Gardner, Isla Española, (Hood I.)	Shallow water	Coral	one
LITHOPHAGA (DIBERUS) SUBULA (REEVE)				
California				
1456-42	Monterey Bay	8 fms	Dredge from Monterey Shale (Middle Miocene) off Del Monte	one
1004-39	Bechers Bay, Santa Rosa I.	13-16 fms	Rock, coralline	two
1660-48	SW shore of Smugglers Cove, Santa Cruz I.	Shore	Rocky reef, loose rock, gravel	five
1415-41	1.5 mi E of Cardwell Pt., San Miguel I.	20-21 fms	Sand, rocks	eight
1295-41	1 mi SE of Smugglers Cove, Santa Cruz I.	15-21 fms	Coralline, sand, pebbles	two
1270-41	0.5 mi S of west end of Anacapa I.	25-26 fms	Coralline, rock	one
1190-40	Anacapa Passage	15-50 fms	Sand, gravel	one
1193-40	Willow Anchorage, S side of Santa Cruz I.	Shore	Beach at low tide	one
1284-41	1 mi S of East Point, Santa Rosa I.	15-16 fms	Loose rock, sand, nullipores	seven
1280-41	2.5 mi E of South Point, Santa Rosa I.	15-21 fms	Shell, red algae	one
	Long Wharf			four

	Off Point del Rey			one
	Portguese Bend			six
	Near Rocky Point	12 fms		one
	S of Point Fermin	32 fms		one
1578-46	0.5 mi off shore, 2 mi W of Pt. Fermin			seven
2320-53	2.2 mi ESE of Los Angeles breakwater light	13 fms	Sand, mud	one
A 615	Off Long Beach	13 fms		five
Acc. 605	Breakwater off Long Beach	20 fms		one
	Outside hole 0.5 mi E of S from Long Beach	90 fms		five, from rock of coralline material
1232-41	5 mi 152° from San Pedro breakwater	18-19 fms	Coarse sand, shell	fourteen
1222-41	Newport and Balboa Channel	Shore	Low tide	one
1224-41	Newport Channel, Balboa	Shore		one
1930-50	Corona del Mar	Shore	Sand, loose and solid rock, eel grass	two
1572-46	Corona del Mar	Intertidal	Rocky shore	two
2000-50	Newport Bay to Corona del Mar	Shore	Rock, eel grass	one
1209-40	Laguna Beach	Shore	Rocky and underlaid, heavy covered sand	one
2049-51	11 mi NE of Avalon, Catalina I.	350-400 fms	Brown mud	nine
1221-40	Avalon, Catalina I.	Shore	Rock	three
	Catalina Harbor			four
1153-40	E of Long Pt., Catalina I.	35-46 fms	Mud bottom	one
BS 1249	Long Pt. to Willow Cove, Catalina I.	45 fms		one valve
1406-41	N side, White Cove, Catalina I.	Shore	Rock, kelp	one small
1363-41	White Cove, Catalina I.	Shore		three
Mexico: Baja California, Pacific coast				
1597-47	N of Punta Descanso, near Islas Coronados	Rocky reef		two
1594-47	Punta Descanso		Rocky	five
2603-54	1.1 mi NW of Kelp Pt., Puerto de San Bartolomé	Shore	Rocky ledge, kelp	one
617-37	Off Punta Pequeña	24 fms	Sand, kelp	one

Station	Location	Depth	Remarks	Specimens
LITHOPHAGA (MYOFORCEPS) ARISTATA (DILLWYN)				
Mexico: Baja California, Pacific coast				
	Bahía del Tortuga		Boring in *Acmaea mexicana*	three
127-33	Bahía de Santa María	Shore, mouth of lagoon		one
Mexico: Gulf of California				
708-37	Puerto Refugio, Isla Angel de la Guarda	60 fms	Sand	one small
1056-40	Puerto Refugio, Isla Angel de la Guarda	6-11 fms	Sand, coralline	one
1053-40	Puerto Refugio, Isla Angel de la Guarda	Shore	Rock	one
1079-40	Isla Pond, Isla Angel de la Guarda	Shore	Rock	two
Station	Location	Depth	Remarks	Specimens
Station	Location	Depth	Remarks	Specimens
Station	Location	Depth	Remarks	Specimens
Station	Location	Depth	Remarks	Specimens
Station	Location	Depth	Remarks	Specimens
Station	Location	Depth	Remarks	Specimens
553-36	Isla Pond, E of Isla Angel de la Guarda	Shore, lagoon and beach		sixteen
700-37	Bahía de los Angeles	Shore	Shingle	one
559-36	S of Isla Partida	45 fms	Sand	thirteen
566-36	S of Isla Tiburón	20 fms	Sand, shell	two
529-36	Off Punta San Francisquito	165 fms	Shale, gray mud	one living
1765-49	Puerto San Carlos, Sonora	1-10 fms	Sponges, mollusks	one
670-37	Puerto Escondido, S of Loreto	Shore	Lagoon entrance	one
591-36	Puerto Escondido, S of Loreto	Shore	Shingle	three and one valve
1749-49	Puerto Escondido, S of Loreto	Eastern shore	Rocky beach	one
1103-40	Bahía de Agua Verde	Shore		two
1737-49	Bahía San Gabriél, Isla Espíritu Santo	1 fm	Coral heads	six
1108-40	Bahía San Gabriél, Isla Espíritu Santo	Shore	Shingle	two
1110-40	Bahía San Gabriél, Isla Espíritu Santo	Shoal	Coral	two small
638-37	Bahía San Gabriél, Isla Espíritu Santo	Shallow water	Coral	thirty-eight
Dawson 68	Mazatlán, Sinaloa, N of Olas Altas light	Shore	Rocks, pools	nineteen
Dawson 69	Mazatlán, Sinaloa, S side of Olas Altas light	Shore	Reefs, rocks	seven
Dawson 53	Cabeza Ballena, near Cabo San Lucas	Shore	Granite reef, pools, surf rocks	one, *in situ*

970-39	Isla María Magdalena, Las Tres Marías	13 fms	Coralline, algae	one
Mexico				
Dawson 85	Barra Navidad, Jalisco	Rocky shore		many small, some *in situ*
131-34	Bahía Braithwaite, Isla Socorro	Shallow water	*Pocillopora* coral	one
130-34	Bahía Braithwaite, Isla Socorro	Shore	Rock, large shingle, tide pools	one
2591-54	Rocas de San Lorenzo, Acapulco	0-2 fms	Rock	fifteen
2596-54	Bahía de Santa Lucía, Acapulco	1-4 fms	Rock, mud, sand	three
Dawson 131	Acapulco, end of peninsula, opposite Isla Roqueta		Reef, rocks	four small
261-34	El Bufadero, Bahía Tangola Tangola	Shallow water	Coral	two small
Dawson 95	Salina Cruz, Oaxaca	Shore of granite headland	Rock	two
Costa Rica				
466-35	Puerto Parker, off Punta Abajo	Shore of small island at entrance	Rock	one small
460-35	Bahía Playa Blanca	3-5 fms	Sand, shells	three
464-35	Bahía Playa Blanca	Shore	Coral	one
473-35	Puerto Parker, off Punta Abajo	Shallow water	Coral	four and one valve
256-34	S of Punta Mala, Boca de Culebra	Shore	Rock	three
258-34	Off Bahía Cocos	Shallow water	Coral	six
107-33	Bahía de Wafer, Isla del Coco	Shore	Rock	two
105-33	Bahía de Wafer, Isla del Coco	Shore	Rock	approx. 35, some *in situ*
Panama				
867-38	Islas Secas	Shallow water	Coral	one
447-35	Islas Secas	Shallow water	Coral	four
444-35	Puerto Piñas	2-4 fms	Coral	seventeen
Colombia				
435-35	Bahía Octavia	Shallow water	Coral	eight
433-35	Bahía Octavia	Shore on island	Shingle	seven
239-34	Puerto Utría	Shore	Reef inside outer island	four
859-38	Puerto Utría	Shallow water	Coral	four

Station	Location	Depth	Remarks	Specimens
419-35	Puerto Utría	Shallow water	Coral	three
413-35	Puerto Utría	Shore	Rock	one small
404-35	Off Isla Gorgona	3 fms	Rock, tangles	three small
412-35	Isla Gorgona	Shallow water	*Pavona* coral	six
411-35	Isla Gorgona	Shallow water	*Pocillopora* coral	one small
Galapagos Islands				
97-33	Bahía de Darwin, Isla Genovesa (Tower I.)	Shallow water	Coral	one
94-33	Bahía de Darwin, Isla Genovesa (Tower I.)	Shallow water	Coral	four small
152-34	Ensenada Tagus, Isla Isabela (Albemarle I.)	Shallow water	Coral	twenty, one boring in a sponge
155-34	Off Ensenada Tagus, Isla Isabela (Albemarle I.)	50-60 fms	Rock, nullipores, bryozoa	two
85-33	Isla Seymour (N. Seymour I.)	Shore	Rock	one small
804-38	Isla Onslow, N of Isla Floreana (Charles I.)	Crater	*Pavona* coral	two
357-35	Bahía de Gardner, Isla Española (Hood I.)	Shallow water	Coral	two
27-33	Bahía de Gardner, Isla Española (Hood I.)	Shore	Rock	two, one with left valve projection lower
Ecuador				
403-35	W of Manta	Reef with breakers		eleven
211-34	Isla La Plata	Shore	Rock	five
22-33	Isla La Plata	Shore	Rock	two
399-35	Isla Salango	8 fms	Sand	one, left valve projection lower
10-33	S of La Puntilla	Shore	Rock	two
12-33	Bahía de Santa Elena, off beach	4 fms	Sand	one small
19-33	Punta Brava, Bahía de Santa Elena	Shore	Rock	one
LITHOPHAGA (LABIS) ATTENUATA (DESHAYES)				
Mexico: Baja California, Pacific coast				
Dawson 14	Miller's Landing, S of Punta Rosarita	Shore	Flat cobblestone reef	one
KG 4	Laguna de Scammon	3.5-8 fms	Rock	two
KG 3	Laguna de Scammon	3-4.5 fms	Rock	two

2603-54	1.1 mi NNE of Kelp Pt., Puerto de San Bartolomé Bahía del Tortuga	Shore	Rocky ledge, kelp	fifty-six large three, boring in *Haliotis*
127-33	Bahía de Santa María	Shore, mouth of lagoon		many
1713-49	Punta Entrada, Bahía de la Magdalena	Shore	Rocky beach	one
1718-49	Canal de Marcy, Bahía de la Magdalena	13 fms	Rock	thirty-one
1719-49	E shore of Isla Santa Margarita	Shore	Sand, rock	two
Mexico: Gulf of California				
2623-54	Bahía de San Felipe	Reef, 1-2 mi N	Sand, rock	two
559-36	S of Isla Partida	45 fms	Sand	one
1749-49	Puerto Escondido, S of Loreto	Eastern shore	Rock, sponges	one
Costa Rica				
460-35	Bahía Playa Blanca	3-5 fms	Sand, shells	three
473-35	Puerto Parker, off Punta Abajo	Shallow water	Coral	two
Ecuador				
850-38	Off Cabo de San Francisco	15 fms	Mud, rock	two
400-35	Bahía de Manta	Shore	Rock, sand	two
403-35	W of Manta	Reef with breakers		one
12-33	Bahía de Santa Elena, off La Libertad	4 fms	Sand	two
Peru				
821-38	Bahía de San Nicolás	Shore	Rock	one
LITHOPHAGA (LABIS) PERUVIANA (ORBIGNY)				
Peru				
832-38	Bahía de la Independencia	10 fms	Sand, shell, algae	one
831-38	Bahía de la Independencia	Shore	Rock	one
835-38	Bahía de la Independencia	18 fms	Rock, sand, shell	ten
LITHOPHAGA (LEIOSOLENUS) SPATIOSA CARPENTER				
Ecuador				
850-38	Off Cabo de San Francisco	15 fms	Mud, rock	one
15-33	Bahía de Santa Elena, off Salinas	10 fms	Sand, shell	one

Station	Location	Depth	Remarks	Specimens
LITHOPHAGA (LEIOSOLENUS) HANCOCKI N. SP.				
Galapagos Islands				
180-34	Bahía de Sulivan, Isla Santiago (James I.)	Shallow water	Coral	nine and one valve
811a-38	Isla Santa Fé (Barrington I.)	Shore	Coral	seven
804-38	Isla Onslow, N of Isla Floreana (Charles I.)	Crater	*Pavona* coral	thirty-seven
194-34	Isla Onslow, N of Isla Floreana (Charles I.)	Crater	Coral	twenty
59-33	Off Punta Cormorant, Isla Floreana (Charles I.)	13 fms	Rock	one

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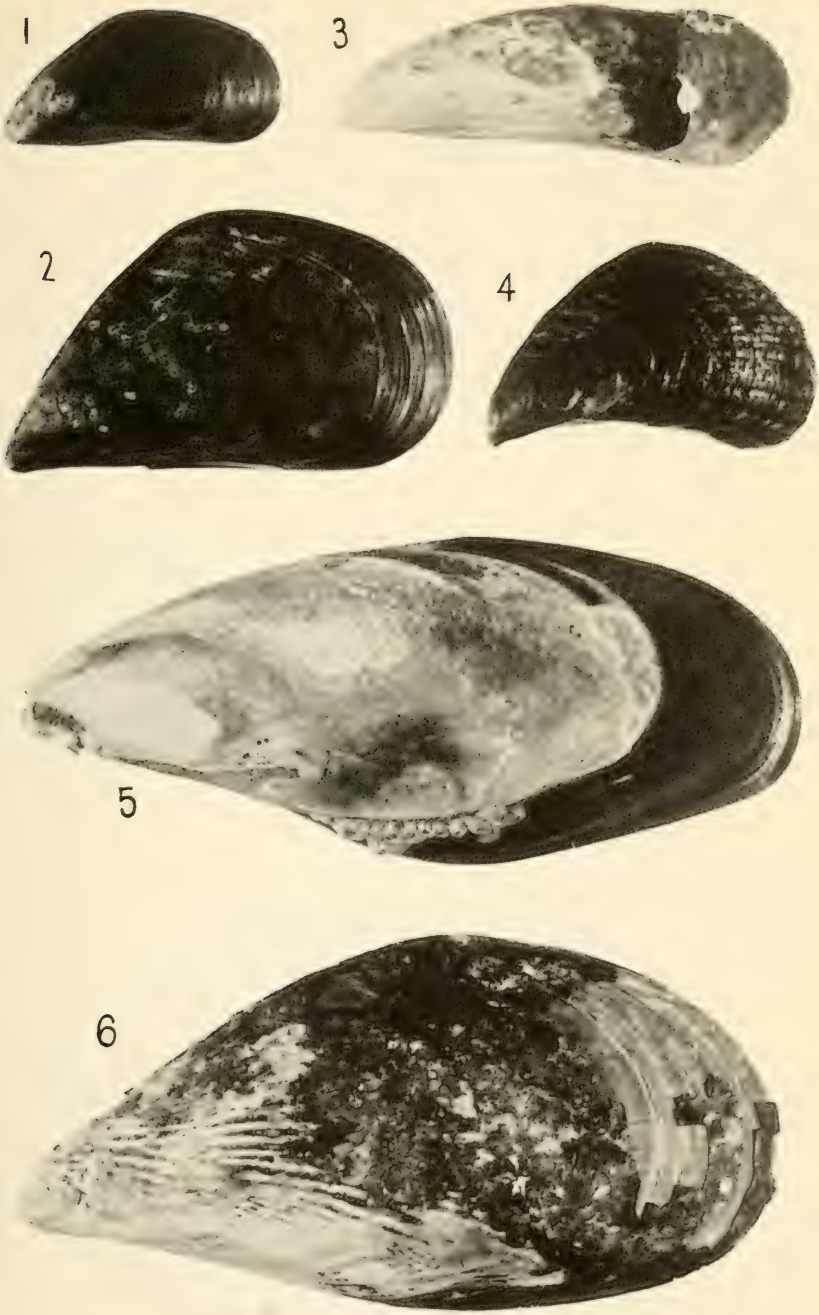
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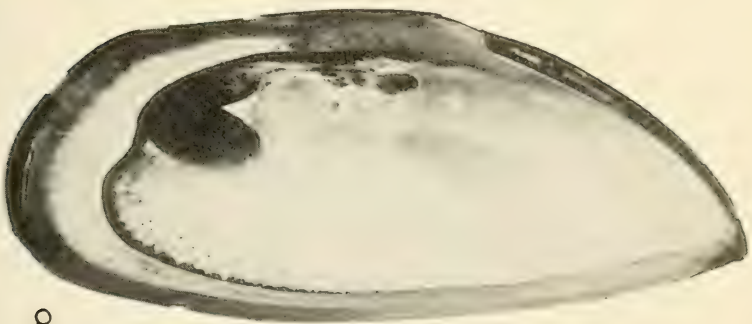

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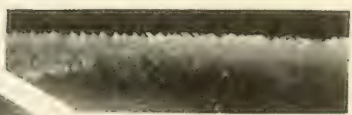

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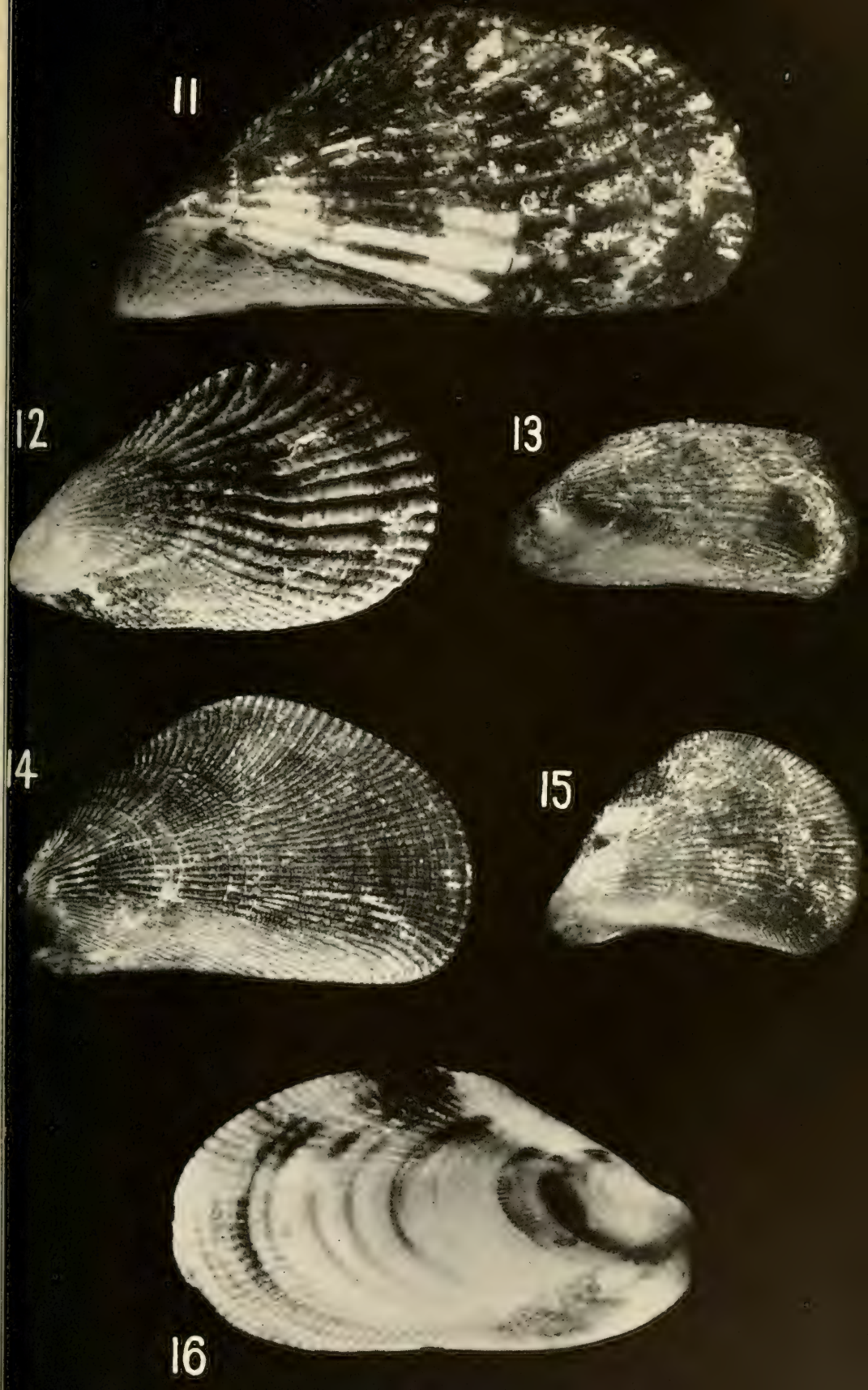
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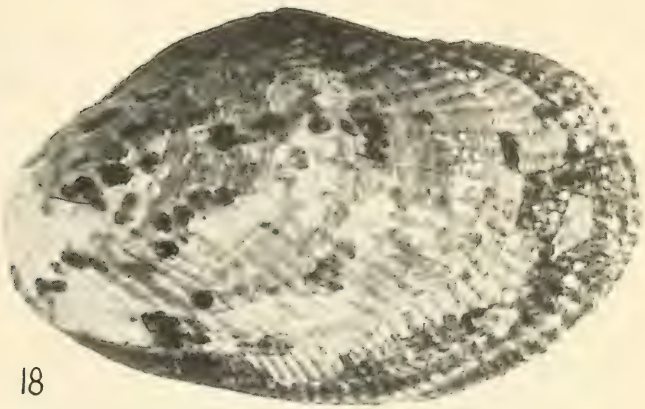

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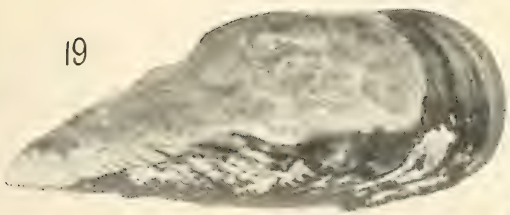

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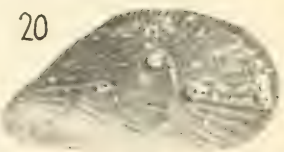

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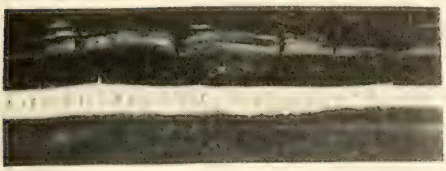

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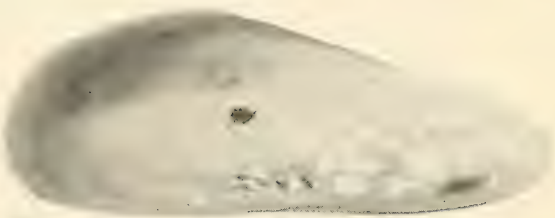

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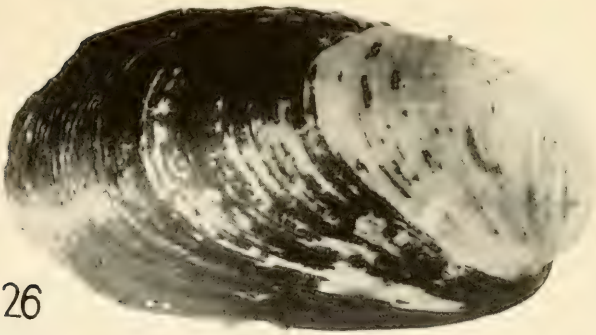

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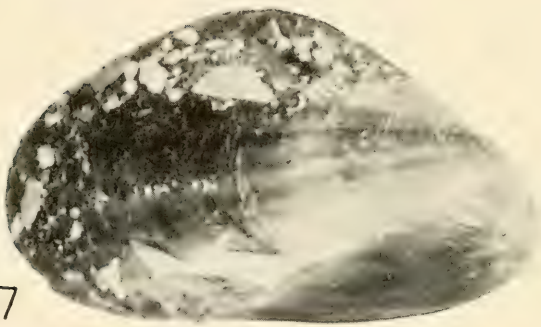

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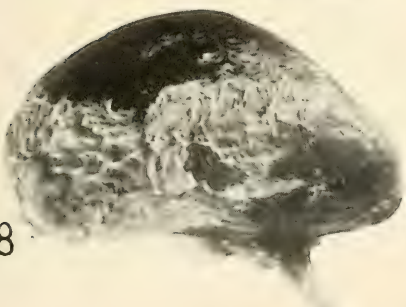

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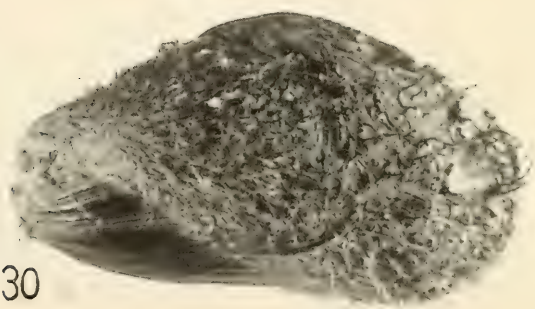

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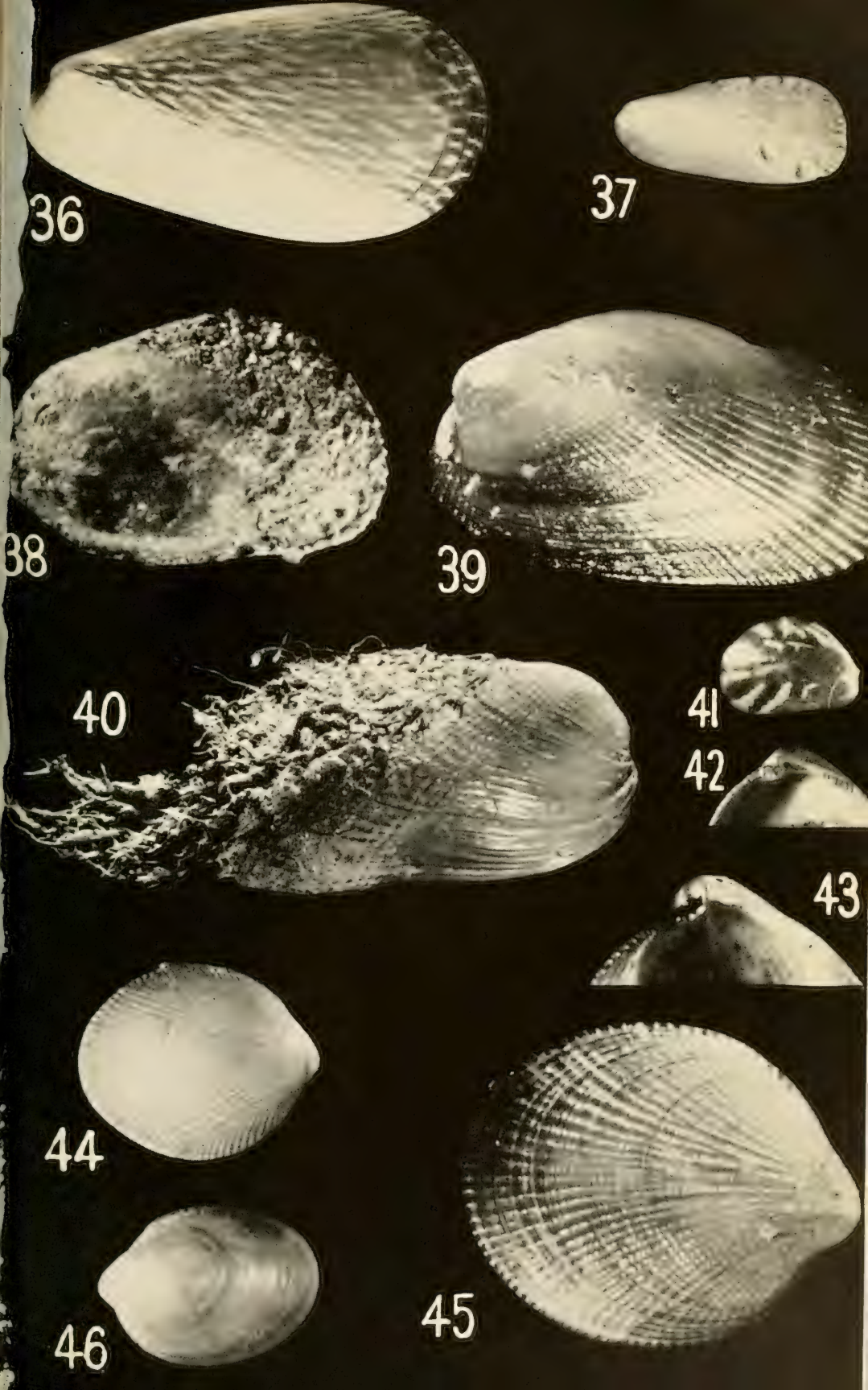
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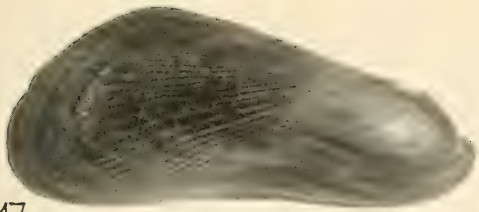

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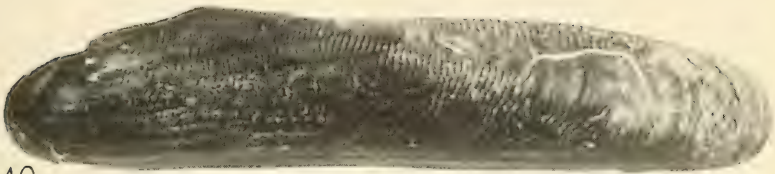

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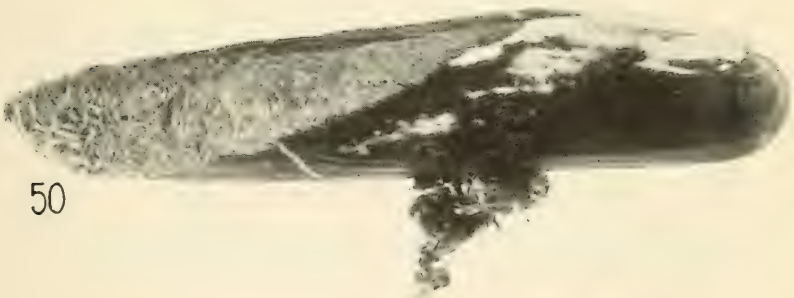

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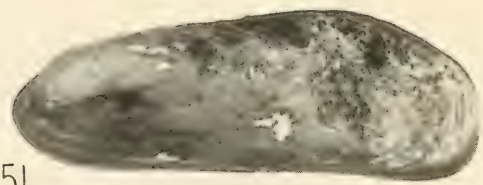

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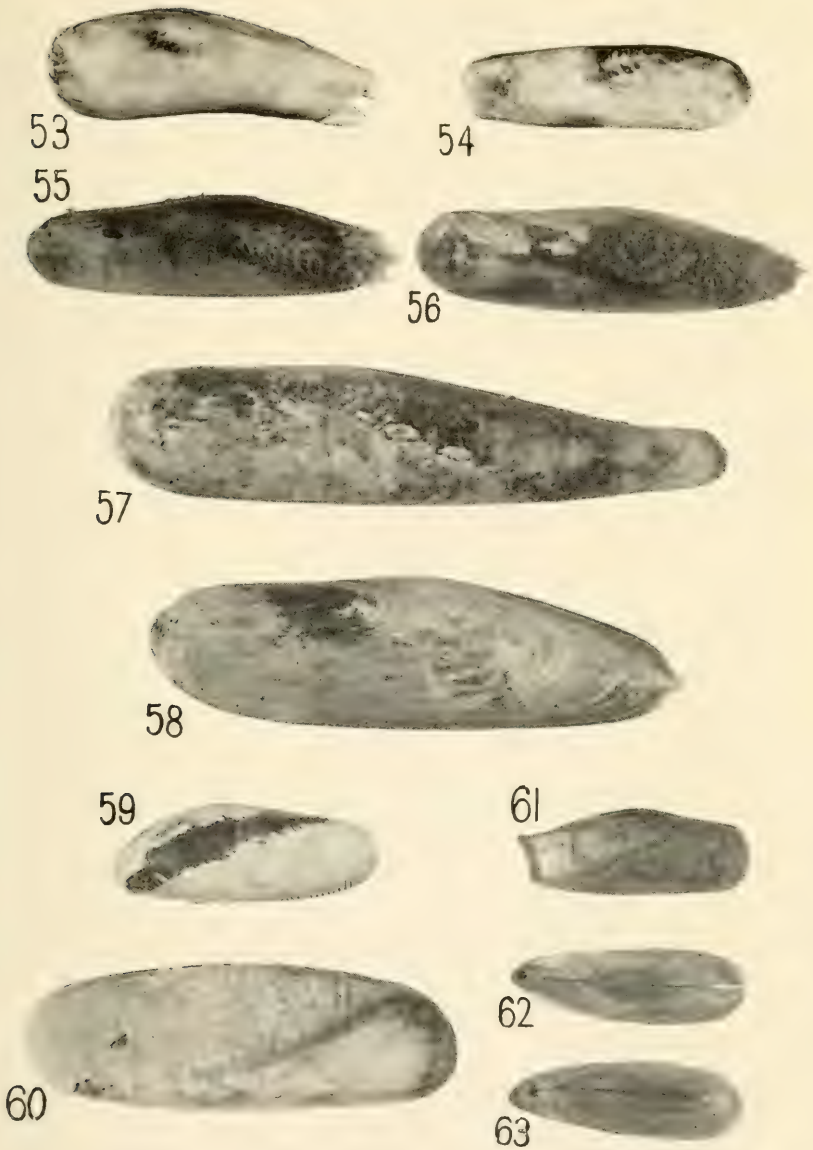
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ALLAN HANCOCK PACIFIC EXPEDITIONS

VOLUME 20 NUMBER 2

A REPORT ON THE FAMILY ARCIDAE
(PELECYPODA)

(PLATES 11-16; TEXT-FIGURES 79-95)

BY

HELEN ROST

THE UNIVERSITY OF SOUTHERN CALIFORNIA PRESS
LOS ANGELES, CALIFORNIA
1955

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PREFACE

The material in the Allan Hancock Foundation contains a very valuable collection of marine mollusks from the Pacific coast of America. I am extremely grateful that I have been allowed to work out the family Arcidae and present the result of my work in this paper.

I beg herewith to render my best thanks to Captain Allan Hancock and the Research Committee of the Allan Hancock Foundation for giving me the opportunity to work as a Research Fellow of the Foundation.

I wish also to express my thanks to the following members of the Allan Hancock Foundation staff: the editor, Mrs. Dorothy M. Halmos, to whom I am extremely indebted for her help in preparing the paper for publication; Dr. Norman T. Mattox, who placed the material in my hands and helped me in different ways during the work; Miss Janet Haig, who kindly corrected my manuscript; Mr. Gaylen C. Hansen, who with great interest and care made the drawings; and Mr. Roy V. George, who made the photographs for the plates. I am also indebted to Dr. S. Stillman Berry, Redlands, Dr. Leo G. Hertlein, California Academy of Sciences, Dr. A. Myra Keen, Stanford University, and Mr. E. P. Chace, San Diego Museum of Natural History, for the use of their collections for comparison. I also wish to thank Dr. E. Reilly, New York State Museum, Albany, for his efforts in trying to locate some of Carpenter's specimens. For discussion and supervision, I am greatly indebted to my principal, Director Tron Soot-Ryen, of Tromsø Museum, Norway.

INTRODUCTION

The purpose of this survey was to study the collection of the family Arcidae from the west coast of America and the Galapagos Islands, collected for the Allan Hancock Foundation during the cruises of the *Velero III* and the *Velero IV* from southern California to northern Peru and the Galapagos Islands.

Twenty five species are present in the material. Descriptions of most of these species will be found in Maury (1922) and in Hertlein and Strong (1943). A complete review of the Mesozoic and Cenozoic Arcidae from the Pacific Slope of North America, with numerous illustrations, is given by Reinhart (1943). A good bibliography for the family is also included in his paper. The synonymies will be found fairly complete in Maury (1922). Anatomical studies of five of the species present have been made by Heath (1941). One or more samples of nineteen of the species are preserved in alcohol. The following six species are represented by dried material only: *Barbatia* (*Calloarca*) *alternata* (Sowerby), *Acar pusilla* (Sowerby), *Anadara tuberculosa* (Sowerby), *A.* (*Larkinia*) *grandis* (Broderip and Sowerby), *A.* (*Scapharca*) *cumingiana* (Nyst), and *Sheldonella delgada* (Lowe). The circumstances did not allow a detailed anatomical study. However, easily seen characters, such as the presence of eye-spots on the mantle margin, and of a byssus, have been described. Schematical drawings have been made of the general appearance of the soft parts from the lateral and dorsal sides, and of the abdominal sense organs.

The systematic arrangement is, with a few changes, that of Reinhart (1943). The subfamily Noetiinae is retained in the family Arcidae.

The number of species has been too small to allow a revision of the systematics of the family. For that, it will be necessary in the future to make more comparisons with species from the Atlantic coast of America, as well as from the western Pacific.

Family **Arcidae**

Subfamily **Arcinae**

Genus **ARCA** Linné 1758

Arca Linné, Systema naturae, ed. 10, p. 693.

Type of genus: Arca noae Linné 1758 (by action of the International Commission on Zoological Nomenclature, Oct. 5, 1944. Opinion 189)

Subgenus **ARCA** s. s.

Arca (Arca) pacifica (Sowerby) 1833

Byssoarca pacifica Sowerby, Proc. Zool. Soc. London, 1833, p. 17.

Fig.: Maury, 1922, Pl. 1, fig. 15; Reinhart, 1943, Pl. 14, figs. 3, 4.

Anatomy: Heath, 1941.

Type loc.: Santa Elena, Ecuador; 6-18 fms.

Holotype: British Museum?

Remarks: This species is extremely variable in form and shell proportions. The posterior expansion is sometimes not very pronounced. Usually, the projection of the posteroventral expansion reaches behind the posterodorsal one. Several authors state that *A.* (*Arca*) *pacifica* is more expanded posteriorly than is the closely related *A.* (*Arca*) *zebra* (Swainson) (= *occidentalis* Philippi) from the Caribbean. This character, however, is not constant, as a specimen of *A.* (*Arca*) *zebra* may sometimes be more expanded posteriorly than a specimen of *A.* (*Arca*) *pacifica* of the same size. It seems difficult to find a really good character to distinguish the two species.

The maximum height of the shell usually has to be measured perpendicular to the posterior part of the shell. Some specimens, however, may have the maximum height perpendicular to the umbo.

The anatomy of this species has been studied by Heath (1941), so only a few observations will be mentioned here. The mantle margin is furnished with eye-spots except for the part where the byssus emerges. The margin is also pigmented with brown spots, and so are the ventral part of the foot and the extreme posterior part of the gills.

The largest specimen in this material measures 128 mm in length, 72 mm in height, and 80.5 mm in diameter. It is from the Gulf of California and was dead when dredged.

Occurrence: Living specimens were dredged between 2 and 50 fms. The bottom usually consisted of sand, shells, and rocks, and the specimens were attached to rocks, shells, corals, or to each other.
Distribution: Laguna de Scammon, Baja California, and the Gulf of California, to Payta, Peru. Also found in the Galapagos Islands, according to Hertlein and Strong (1943).

Arca (Arca) mutabilis (Sowerby) 1833

Pl. 11, figs. 1-2; text-figs. 79, 80 a-c

Byssoarca mutabilis Sowerby, Proc. Zool. Soc. London, 1833, p. 17.
Fig.: Reinhart, 1943, Pl. 11, figs. 8-10.
Type loc.: Isla La Plata, Ecuador; under stones.
Holotype: British Museum?
Remarks: Two specimens are figured to show the variation of the ligamental area (Pl. 11, figs. 1-2). Text-fig. 79 shows the arrangement of the periostracum in a beautifully preserved specimen. The periostracum is yellowish-brown, foliaceous and serrated; it is usually better developed on the umbonal keel and is not so easily worn off on this part of the shell.

Eye-spots are present around the whole mantle margin. They are rather large posteriorly, and very small elsewhere.

The largest specimen in the collection, obtained by shore collecting in the Gulf of California, has a length of 41.2 mm. Other measurements would not be accurate, as the specimen is very eroded.
Occurrence: The common habitat for this species is under rocks at low tide, but it is occasionally dredged down to 45 fms (reported by Hertlein and Strong, 1943). One sample in the material at hand contains 14 specimens from the Galapagos Islands. They are typical *Arca mutabilis* and not *Arca ventricosa* Lamarck 1819 (= *truncata* (Sowerby) 1833), which has been reported from the Galapagos Islands.
Distribution: Bahía de la Magdalena, west coast of Baja California, and the Gulf of California to Ecuador (Hertlein and Strong, 1943). Galapagos Islands. In the Pleistocene of Ventura County, California (Reinhart, 1943).

Genus BARBATIA Gray 1842

Barbatia Gray, Synopsis of the Contents of the British Museum, ed. 44, 1842, p. 81.
Type of genus: Arca barbata Linné 1758. (Subsequent designation by Gray, 1847, p. 197).

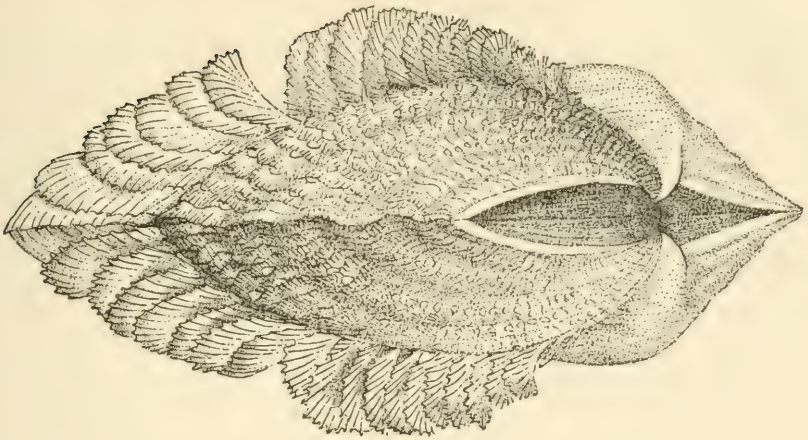

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Fig. 79. *Arca mutabilis* (Sowerby) 1833. Puerto Parker, Costa Rica. Shell with periostracum seen from the posterodorsal side. Length, 20 mm.

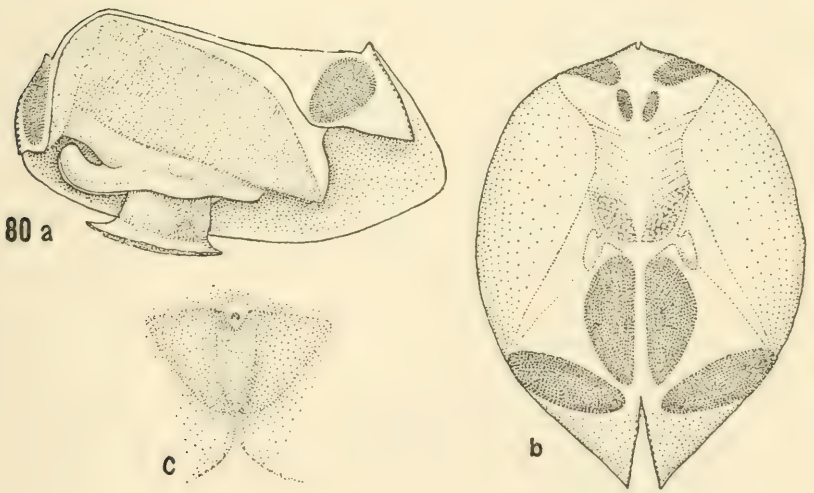

Fig. 80. *Arca mutabilis* (Sowerby) 1833. Isla Isabel, Gulf of California. a. Lateral view. b. Dorsal view. c. Abdominal sense organs. Length, 30.8 mm.

Subgenus **BARBATIA** *s. s.*

Remarks: The differences between this group and subgenus *Cucullaearca* Conrad are discussed under the latter group.

I have examined two species belonging to this subgenus, *B.* (*Barbatia*) *cancellaria* (Lamarck) from Florida, and *B.* (*Barbatia*) *lurida* (Sowerby) from Baja California. They were both furnished with pigmented eye-spots along the whole mantle margin, especially abundant in the posterior and extreme anterior part. Patten (1886, p. 550) counted between 400 and 500 eye-spots on *B.* (*Barbatia*) *barbata* (Linné) from the Mediterranean. This arrangement is different from that found in *Cucullaearca* (see under this subgenus).

Heath (1941) has studied the anatomy of *"Barbatia barbata"* from Florida, which is probably *B.* (*Barbatia*) *cancellaria* (Lamarck) 1819 (= *listeri* (Philippi) 1849, not Lamarck, Kobelt 1891). This may explain the difference Heath found in the stomach feature (p. 294) from the *B. barbata* examined by Matthias (1914), who had specimens from the Mediterranean. *B.* (*Barbatia*) *barbata* (Linné) occurs only in the Mediterranean. Several authors, however, have reported it from the Caribbean, e.g., Sheldon (1916), who gives some illustrations of *"Barbatia barbata"* from the West Indies (Pl. 2, figs. 5-7). Reinhart (1935, p. 25-26) did not recognize Sheldon's species, but said it must belong to the subgenus *Obliquarca* Sacco 1898 or at least to a closely related group, because of the arrangement of the ligament in Sheldon's figure 7. This may be the same condition found in *B.* (*Cucullaearca*) *reeveana* (Orbigny) (see Pl. 11, fig. 5b), small specimens of which have the ligament only behind the umbones, although it occupies the whole cardinal area in adult specimens.

Barbatia (Barbatia) lurida (Sowerby) 1833

Pl. 11, figs. 3 a-b; text-figs. 81 a-c

Byssoarca lurida Sowerby, Proc. Zool. Soc. London, 1833, p. 19.

Syn.: ?Byssoarca vespertilio Carpenter 1856.

?Byssoarca fusca Carpenter 1856.

?Barbatia solidula Dunker 1868.

Type loc.: Santa Elena, Ecuador; 12 fms; attached to stones, rocky ground. (*Byssoarca vespertilio:* Mazatlán, Mexico)

Holotype: British Museum?

Remarks: Byssoarca vespertilio Carpenter is quite probably a synonym of *Barbatia lurida* (see discussion by Maury, 1922, pp. 12-13, and

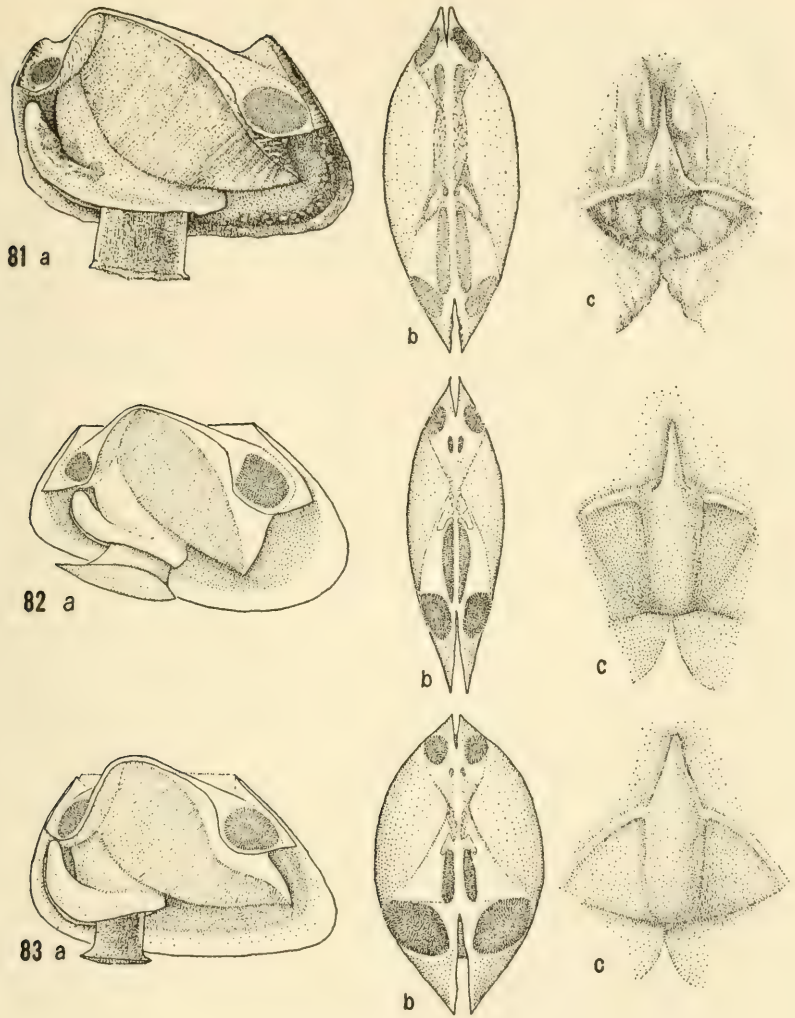

Fig. 81. *Barbatia lurida* (Sowerby) 1833. Isla Espíritu Santo, Gulf of California. a. Lateral view. b. Dorsal view. c. Abdominal sense organs. Length, 28.7 mm.

Fig. 82. *B.* (*Cucullaearca*) *reeveana* (Orbigny) 1846. South Seymour Island, Galapagos Islands. a. Lateral view. b. Dorsal view. c. Abdominal sense organs. Length, 52.5 mm.

Fig. 83. *B.* (*Fugleria*) *illota* (Sowerby) 1833. Off Puerto Escondido, Gulf of California. a. Lateral view. b. Dorsal view. c. Abdominal sense organs. Length, 25 mm.

Reinhart, 1943, p. 30), but the type must be examined to settle the question properly. Although Palmer (1951) lists *Byssoarca vespertilio* (no. 192) as present among the first duplicate series of the Reigen Mazatlan Collection deposited by Carpenter in the New York State Museum in Albany, it has been impossible to locate the sample in the Museum. *Byssoarca fusca,* reported from Mazatlán by Carpenter (1856a, p. 140), might perhaps be *Barbatia lurida* also.

The shells at hand have a white ray radiating from the umbo, similar to that of the Caribbean species *Barbatia cancellaria* (Lamarck). The periostracum fits the description of *Byssoarca vespertilio* given by Carpenter (1856a, p. 141), and is soft and lamellose anteriorly. The bristles may be more or less worn off, especially on the median part.

Small and large eye-spots are present around the whole mantle margin. The posterior part of the mantle margin is especially heavily pigmented. Also pigmented are the foot, the anal region, and the posterior part of the gills. The abdominal sense organs are of the same type as those of *"Barbatia barbata"* (= *cancellaria* (Lamarck) 1819) (Heath, 1941, Pl. 5, fig. 10). Measurements of the largest specimen in the present collection (1737-49) are length, 38.6 mm; height, 21.5 mm; diameter, 17.2 mm.

Occurrence: Rather rarely taken in the intertidal zone down to 12 fms, attached to rocks.

Distribution: Isla Espiritu Santo, Gulf of California, to Zorritos, Peru (the Peru locality reported by Olsson, 1924). The Galapagos Islands (one valve in the present material).

Subgenus **CUCULLAEARCA** Conrad 1865

Cucullaearca Conrad, Amer. Jour. Conch., vol. 1, 1865, p. 11.

Type of subgenus: Byssoarca lima Conrad 1847. (Subsequent designation by Stoliczka, 1871, p. 340)

Remarks: The main characters distinguishing this group from *Barbatia s. s.,* according to Reinhart (1935), are a wider ligamental area, larger byssal gape, and posterior enlargement in outline. A posterior enlargement in outline cannot be used as a subgeneric character, as the form is extremely variable.

According to Heath (1941), who had only a few species for examination, the anatomy did not show any distinguishing characters between *Barbatia s. s.* and *Cucullaearca.*

I have examined *B.* (*Cucullaearca*) *reeveana* (Orbigny), the Pacific coast species, and the Atlantic species *B.* (*Cucullaearca*) *candida* (Helbling). Both had only one distinct eye-spot on the anterior part of each mantle margin. A similar arrangement of eyes was found by Pelseneer (1911, Pl. 3, fig. 4) in *B.* (*Cucullaearca*) *nivea* (Chemnitz), a species belonging to the same group. As mentioned before, species belonging to *Barbatia s. s.* seem to have heavily pigmented mantle margins with eyespots all around.

Subgenus *Cucullaearca,* therefore, seems to constitute a supraspecific unit.

Barbatia (Cucullaearca) reeveana (Orbigny) 1846

Pl. 11, figs. 4, 5, 9; text-figs. 82 a-c

Arca reeveana Orbigny, Voyage dans l'Amérique Méridionale, vol. 5, pt. 3, 1846, pp. 635-636. New name for *Arca helblingii* Bruguière, Reeve 1844 (Conch. Icon., vol. 2. *Arca,* species 90). Not *Arca helblingii* Bruguière 1792.

Syn.: ?Barbatia nova Mabille 1895.

Fig.: Maury, 1922, Pl. 2, figs. 13, 15-17; Reinhart, 1943, Pl. 15, figs. 1-3.

Type loc.: Santa Elena, Ecuador (designated by Hertlein and Strong, 1943).

Holotype: British Museum ? (Reeve's specimen)

Remarks: Sheldon and Maury in Maury, 1922, have described two varieties of this species, *lasperlensis* and *velataformis.* These varieties are not taken into consideration in this paper, as *Barbatia* (*Cucullaearca*) *reeveana* is variable in form depending upon its environment and so the separation of different forms has no value. The shell is shaped according to the place of its attachment and the space it has at its disposal. Maury (1922, Pl. 2, figs. 13, 15, 17) gives figures of specimens with variations in form. The number of posterior ribs is also variable, but seven coarse ribs can usually be counted. The sinus for the byssal gape is usually larger in the right valve. Sometimes, in small and in unworn specimens, one of the valves is complete, with the byssal gape cut in the other valve only.

The periostracum consists of dark brown spinelike projections, sometimes in pairs arranged in concentric rows (Pl. 11, fig. 4). The "spines" are connected by a thin brownish-yellow membrane and become very stiff on the posterior part of the shell.

In small specimens the ligament is yellowish-brown and is present only posterior to the umbones (Pl. 11, fig. 5b), while in full grown animals it becomes darker and occupies the entire cardinal area.

The prodissoconch may be easily seen in small specimens (Pl. 11, fig. 9). It is yellow and distinctly set off from the rest of the shell by its color. Its shape is round to triangular, inflated. The hinge line appears to be much shorter than the length of the prodissoconch, but is concealed by the curved, inflated umbones. The surface is granular and indistinct radiating ridges are indicated on the posterior slope. This type of prodissoconch resembles the figure given by Bernard (1898, Pl. 1, fig. 13) of *Arca* sp. He also describes the prodissoconch as yellow (p. 89) and furnished with "ponctuations."

The anterior mantle margin is furnished with one distinct black pigmented eye-spot on each mantle.

The largest specimen in the collection measures 94.8 mm in length, 58.7 mm in height, and 41.8 mm in diameter. It was obtained by shore collecting at Isla Angel de la Guarda in the Gulf of California (1053-40).

Occurrence: Usual habitat is under rocks in the intertidal zone. It is occasionally dredged down to 55 fms.

Distribution: Laguna Manuela, Bahía de Vizcaíno, west coast of Baja California, and the Gulf of California, to Zorritos, Peru. The Galapagos Islands. Keen (1937) gives its range north to 34° N. Ballast?

Subgenus **CALLOARCA** Gray 1857

Calloarca Gray, Ann. and Mag. Nat. Hist., ser. 2, vol. 19, 1857, p. 369.
Type of subgenus: Byssoarca alternata Sowerby 1833 (by monotypy).

Barbatia (Calloarca) alternata (Sowerby) 1833

Byssoarca alternata Sowerby, Proc. Zool. Soc. London, 1833, p. 17.
Fig.: Maury, 1922, Pl. 2, fig. 11; Reinhart, 1943, Pl. 11, figs. 5-7.
Type loc.: Western Colombia; 12 fms; attached to stones on rocky bottom.
Holotype: British Museum?
Remarks: Although this is an easily recognized species, very small specimens might be difficult to separate from very small specimens of *Barbatia* (*Cucullaearca*) *reeveana. Barbatia alternata,* however, can be distinguished by the broad, close-set ribs in the middle part of the shell. In small specimens in the material at hand, the prodissoconch is shiny white,

while in *B. reeveana* it is always bright yellow. The edentulous gap in the hinge seems to be more pronounced in juvenile specimens than in adults.

Occurrence: The species is reported from 4 to 15 fms on different kinds of bottom. However, it seems to live attached to rocks or other hard substances (shells, etc.).

Distribution: Punta Peñasco, Sonora, Gulf of California, Mexico, to Ecuador. Also found in the Pleistocene in Bahía de la Magdalena, Baja California(Hertlein and Strong, 1943).

Subgenus **FUGLERIA** Reinhart 1937

Fugleria Reinhart, Jour. of Paleontol., vol. 11, no. 3, 1937, p. 184.

Type of subgenus: Barbatia (Fugleria) pseudoillota Reinhart 1937, Pliocene. (orig.)

Barbatia (Fugleria) illota (Sowerby) 1833

Pl. 11, figs. 6-8; text-figs. 83 a-c

Byssoarca illota Sowerby, Proc. Zool. Soc. London, 1833, p. 18.

Syn.: Arca tabogensis C. B. Adams 1852.

Fig.: Reeve, Conch. Icon., vol. 2, *Arca,* species 78; Maury, 1922, Pl. 2, fig. 8.

Type loc.: Golfo de Nicoya, Costa Rica; under stones.

Holotype: British Museum?

Remarks: Reinhart (1937) placed this species in the subgenus *Fugleria.* The posterior teeth, according to him, are totally absent in the type of the subgenus, but in *Barbatia illota* they are well developed (Pl. 11, figs. 6-8). As may be seen from the illustrations, both the posterior and the anterior teeth are distinctly striated. The teeth in the center of the hinge become granular and very irregular with increase of size; sometimes, especially in specimens of great length, they become quite obsolete for a long distance in the center of the hinge (Pl. 11, fig. 6).

The ligamental area is relatively narrow and the flattened anterior part is covered by a horny light brown periostracum. In young specimens the ligament consists of a few grooves (two in a specimen of 17 mm length) posterior to the umbones. In larger specimens, the grooves develop in both directions and become V-shaped, as in *Cucullaearca* (see Maury, 1922, p. 20), though not as pronounced as in this subgenus; the apex of the V lies just under the umbones. One specimen of 23 mm length has three V-shaped grooves, two of them reaching the hinge line before the umbo; another, measuring 35 mm in length, 24.3 mm in

height, and 21.3 mm in diameter, has seven grooves, three of them reaching before the umbo.

The periostracum consists of fine hairs connected with a foliaceous membrane. The hairs reach beyond the edge of the membrane, forming serrations. The mantle margins are unpigmented. The abdominal sense organs resemble those found by Heath (1941) in *"Barbatia barbata."* The byssus is well developed.

The H/L ratio varies between 50 % and 75%, the D/L ratio between 43% and 57%. The largest specimen in this collection measures 38.1 mm in length, 19 mm in height, and 15.5 mm in diameter. It is from Puerto Utría, Colombia, shore (232-34).

Occurrence: B. (*Fugleria*) *illota* is usually taken in the intertidal zone attached to rocks. The species has also been dredged in 34 and 40 fms.

Distribution: Isla Angel de la Guarda, Gulf of California, to Lobitos, Peru (the Peru locality reported by Olsson, 1924).

Genus **ACAR** Gray 1857

Acar Gray, Ann. and Mag. Nat. Hist., ser. 2, vol. 19, 1857, p. 369.

Type of genus: Arca divaricata (Sowerby) 1833. (Subsequent designation by Stoliczka, 1871).

Remarks: As pointed out by Bartsch (1931), *Acar* is such a distinct unit of the subfamily Arcinae that it ought to be given generic rank. In the *Acar*-group, however, each species is not distinctly circumscribed, and the variability of the species makes it a very puzzling and interesting genus. The present material contains approximately 80 samples of *Acar,* ranging from southern California to Peru and the Galapagos Islands.

One species group, known as *Acar gradata* (Broderip and Sowerby) 1829, reaches a relatively large size and occurs in two forms, one coarsely sculptured (*panamensis* Bartsch 1931) and one finely sculptured (*gradata* Bartsch 1931). Reinhart (1939, Pl. 3, figs. 1a, 1b) shows that the holotype is the coarsely sculptured form, which makes *panamensis* Bartsch a synonym of *gradata,* leaving the finely sculptured form without a separate name. Reinhart (1939, 1943) considers it unnecessary to treat them as different varieties, as it sometimes may be difficult to decide whether a specimen belongs to the finely or coarsely sculptured form, and as the distribution of the two forms almost coincides. The two forms are not treated separately in the present paper.*

*After the present manuscript was finished, Dr. S. Stillman Berry (Leaflets of Malacology, vol. 1, no. 12, July 1, 1954) gave this form a new name, *Barbatia* (*Acar*) *rostae,* considering it to be a valid species with good characters separating it from *A. gradata.*

Another group of Acars, containing species which never reach the size of *Acar gradata,* at its northern limit is named *Acar bailyi* Bartsch 1931 (=*pernoides* Strong 1932, perhaps not Carpenter 1856b), with type locality Balboa, California; and at its southern limit is named *Acar pusilla* (Sowerby) 1833, with type locality Iquique, northern Chile. The range of *A. bailyi* is given by Reinhart (1943) as from Topanga Beach (near Santa Monica), California, to Geronimo Island, Gulf of California (H. N. Lowe collection).

In the material at hand, specimens very close to *Acar bailyi* were found on the Mexican islands, Socorro, Clarión, Isabel, etc., and on the Islas Secas, Panama, as well as on the Galapagos Islands. As it has been impossible for me to find distinguishing characters, they are here treated under *A. bailyi.*

Garth (1946) discussed species of Brachyura which have a similar distribution: species which occur in Baja California and the Gulf of California and reach the Galapagos Islands via the Mexican islands, some of them also occurring in the Bahía de Panamá. He also discussed the causes of such a distribution.

One sample in the material from Ecuador seems to represent specimens of *Acar pusilla* (Sowerby), a little known species which is very close to *A. bailyi.*

Acar gradata (Broderip and Sowerby) 1829

Pl. 12, figs. 11-12

Arca gradata Broderip and Sowerby, Zool. Jour. London, vol. 4, 1829, pp. 365-366.

Syn.: Arca (*Byssoarca*) *pholadiformis* C. B. Adams 1852 (not *A. pholadiformis* Orbigny 1844).

Barbatia (*Acar*) *reticulata* Dall 1898, *non* Gmelin 1791.

Acar panamensis Bartsch 1931.

Fig.: Maury, 1922, Pl. 2, figs. 4, 6, 9; Bartsch, 1931; Reinhart, 1939, Pl. 3, figs. 1a, 1b. (Holotype)

Anatomy: Heath, 1941.

Type loc.: Mazatlán, Mexico.

Holotype: British Museum. Zoological Dept. no. 58.5.12-100.

Remarks: As discussed under genus *Acar,* this species may be coarsely or finely sculptured. The finely sculptured form is in the minority in the present material. Some samples contain both fine and coarse specimens. Judging from the material at hand, the finely sculptured form is most common at the extremities of the range of the species, namely, in Baja California and Ecuador, whatever the cause may be.

The teeth are very distinctly transversely striated, often somewhat irregularly. *Acar gradata* has tiny black pigmented eye-spots along the whole mantle margin except for the foot-aperture part.

It has been discussed whether *Acar gradata* ought to be considered conspecific with the West Indian *Acar domingensis* (Lamarck) = *reticulata* Dall 1898, *non* Gmelin (see Reinhart, 1939, pp. 42-43). Heath (1941) found several distinguishing characters in the anatomy of the two species.

Occurrence: Intertidal on rocky shores. Occasionally taken down to 20 fms.

Distribution: Laguna de Scammon, west coast of Baja California, the Gulf of California, to Negritos, Peru (the Peru locality reported by Olsson, 1924). The Galapagos Islands.

Acar bailyi Bartsch 1931

Pl. 12, figs. 14, 15 a-e

Acar bailyi Bartsch, Proc. U. S. Natl. Mus., vol. 80, art. 9, 1931, p. 2.

Syn.: Acar gradata auct. non Broderip and Sowerby 1829.

Arcopsis solida auct. non Sowerby 1833.

Acar pernoides Strong 1932 (perhaps not Carpenter 1856).

Fig.: Bartsch, 1931, Pl. 1, five middle figures; Reinhart, 1939, Pl. 3, figs. 3 a-d.

Anatomy: Heath, 1941 (*Barbatia* (*Acar*) *pernoides*).

Type loc.: Balboa, (near San Diego), California; under stones.

Holotype: U. S. National Museum no. 382474.

Remarks: There has been much discussion about the correct name for this species (see Strong, 1932, and Reinhart, 1943, pp. 35-36, 82). Carpenter (1856b) described *Byssoarca pernoides* from San Diego from a single valve with a length of about 17 mm, but the description is not sufficient to allow a recognition of the species and it has been impossible to locate the type, which is supposed to be in the Gould collection. Until the type specimen is examined, it is best not to use the name *pernoides*.

The figure of the holotype of *Acar bailyi* Bartsch shows a shell with slightly fainter radial sculpture on the middle of the disc, resembling the southern species *Acar pusilla* (Sowerby). This character seems to be typical for specimens from southern California.

Many samples from the Gulf of California down to Panama and the Galapagos Islands are here referred to *Acar bailyi,* but they are slightly larger and more even in sculpture. They have probably been recorded earlier as *Arcopsis solida* or *Acar gradata* from these more southern

localities. As specimens of *Acar pusilla* (Sowerby) from Ecuador to Chile, and these specimens from southern California are very like each other, it is possible that we have to do with a more widely distributed species which occurs in a larger form in the intermediate area, especially on the islands, and which therefore could be named *Acar pusilla forma insularis*. It is sometimes difficult to separate it from young specimens of *Acar gradata*. *A. bailyi* has distinctly striated teeth and the same arrangement of pigmented eye-spots as has *A. gradata*.

Heath (1941) has made an interesting survey of the anatomy of this species (*"Barbatia (Acar) pernoides"* from off Baja California). He shows that in several anatomical structures, this species is different not only from other species of the genus *Acar* (*gradata* and *"reticulata"*), but from all other Arcas he has studied.

The largest specimen of *Acar bailyi* in this material, from Isla de Clarión (140-34), measures 13.3 mm in length, 8 mm in height, and 7.8 mm in diameter. Many specimens have a very large diameter, often measuring more than the height.

Occurrence: Intertidal on rocky shores, and also in shallow water on coral reefs, where it seems to thrive very well. One sample with ten specimens is labelled 274-34, a station off Navidad Head, Mexico, which according to the station list is from 50 fms, with bottom of mud and sand. The record seems questionable, as all other samples with living specimens are either intertidal or from shallow water. Previously, it was believed to be a more northern species (see Strong, 1932, pp. 27-29; Reinhart, 1939, p. 42). Reinhart (1943, p. 35) gives its range from Topanga Beach, near Santa Monica, California, to Geronimo Island, Gulf of California.

Distribution: Santa Monica, California, to Panama; the Galapagos Islands.

Acar pusilla (Sowerby) 1833

Pl. 12, fig. 13

Byssoarca pusilla Sowerby, Proc. Zool. Soc. London, 1833, pp. 18-19.

Syn.: ?Acar gradata (finely sculptured form) *auct. non* Broderip and Sowerby 1829.

Fig.: Reinhart, 1939, Pl. 3, figs. 2a, 2b. (Holotype)

Type loc.: Iquique, Chile; attached to stones at low water.

Holotype: British Museum. Zool. Dept. No. 58.5.12-100.

Remarks: One sample from Isla La Plata, Ecuador, containing seven specimens, represents this species. An illustration is given for comparison

with Reinhart's figure of the type. The species is easily recognized by the lacking or faintly developed radiating sculpture on the median part of the shell. It is small, the largest specimen at hand having a length of 8 mm, the type of about 11 mm. The teeth are striated as in *Acar gradata.* No specimen is preserved in alcohol. It can be seen from the dried-out animals, however, that *Acar pusilla* has a strong byssus and is furnished with the same arrangement of eye-spots as *A. gradata.*

Dall (1910) and others refer to Reeve, 1844, Pl. 16, fig. 112, as this species. This is wrong, as shown by Maury (1922, pp. 19-20). *Acar pusilla* is not figured in Conchologia Iconica, Reeve's species being similar to the finely sculptured form of *A. gradata.* Carpenter (1856a, p. 142), who apparently had seen the type of *A. pusilla,* indicates that the *pusilla* of Orbigny might be a dwarf variety of *A. gradata.* However, as Orbigny (1846, p. 633) reports *A. pusilla* from Peru, and from Arica and Cobija, Chile (22° 30′ S. lat.), it is questionable if his records were *A. gradata.* Orbigny also refers to Reeve's species 112.

Occurrence: Intertidal on rocky shores. The only sample in the present collection is from Isla La Plata, Ecuador.

Distribution: Dall (1910) gives its range from the "coast of Ecuador, and south to S. lat. 23° 37′" (Isla Blanca, Chile).

Genus **ARCOPSIS** von Koenen 1885

Arcopsis von Koenen, Abh. Gesell. der Wiss. Göttingen. Physik. Kl., Bd. 32, Tl. 2, 1885, p. 86.

Type of genus: Arca limopsis von Koenen 1885 (subsequent designation by Reinhart, 1935).

Remarks: Species belonging to *Arcopsis* have a rhomboidal, transversely striated ligament. The genus is related to the fossil genus *Striarca* Conrad 1862. MacNeil (1938) raises *Striarca* to subfamily rank and refers it to the family Noetiidae, which in turn he refers to the superfamily Glycymeracea. Genus *Arcopsis* is placed in the subfamily Striarcinae. This classification is not followed in the present paper. (Cfr. discussion by Reinhart, 1943, p. 5 and pp. 76-77.)

Arcopsis solida (Sowerby) 1833

Pl. 12, fig. 10; Pl. 13, fig. 16

Byssoarca solida Sowerby, Proc. Zool. Soc. London, 1833, p. 18.

Fig.: Maury, 1922, Pl. 2, figs. 7, 12.

Anatomy: Heath, 1941.

Type loc.: Payta, Peru; under stones.
Holotype: British Museum?
Remarks: Although the West Atlantic species, *Arcopsis adamsi* (Dall) 1886, is very similar to *A. solida,* Heath (1941) found that the two species differ in several anatomical details. Both species have one pigmented eye-spot on the anterior end of each mantle margin, just where the two margins join each other dorsally.

Arcopsis solida attains a length of 20 mm (Maury, 1922, p. 21). The other measurements of the same shell are: height, 14 mm; diameter, 14 mm. The D/L ratio increases with increasing length.
Occurrence: This species is common in the intertidal zone among shingle, sand, and rocks. It is also often taken in depths down to 30 or 40 fms, on bottom of sand, shells, and rocks.

So far as is known, no living specimens have been taken in California, although Keen (1937) gives its range to 34° N. (See discussion in the Minutes of the Conchological Club of Southern California, no. 34, April, 1944, pp. 5-6). *Arcopsis solida* is commonly confounded in collections with species of the genus *Acar,* in spite of the fact that the character of the ligament distinguishes the two genera very easily and no confusion should be necessary.
Distribution: Bahía de Vizcaíno, west coast of Baja California, and Gulf of California, to Payta, Peru. The Galapagos Islands.

Subfamily **Anadarinae** Reinhart 1935

Genus **ANADARA** Gray 1847

Anadara Gray, Proc. Zool. Soc. London, 1847, p. 198.
Type of genus: Arca antiquata Linné 1758 (orig.).
Remarks: The species of genus *Anadara* from the region covered in the present paper are placed in four subgenera: *Anadara s. s., Larkinia* Reinhart 1935, *Scapharca* Gray 1847, and *Cunearca* Dall 1898, in the arrangement used by Reinhart (1943). *Anadara s. s.* contains equivalve species with an equal sculpture on both valves. *Larkinia* is distinguished by having teeth converging at the extremities of the hinge but diverging in the center; it is also described as equivalve, a character which cannot be used for separation, as one species included, *Anadara* (*Larkinia*) *multicostata* (Sowerby), is inequivalve. In *Cunearca* are found inequivalve species with strongly discrepant sculpture on the two valves. *Scapharca* is used for species which do not fit in any of the other subgenera, or species which fall in between *Anadara s. s.* and *Cunearca.*

Unfortunately, this unsatisfactory arrangement must also be followed in the present paper. To make a more natural and correct system, species from all regions of the world would have to be carefully studied. However, the present material may give some indication of relationships. The arrangement of the abdominal sense organs is shown by Heath (1941) to be a good character for generic classification. But of course many characters must be studied and used together for proper determination. As shown in text fig. 90c, *Anadara obesa* (Sowerby), which has always been placed in *Scapharca* because it has smooth ribs and is inequivalve, has the structure of the anal region like that of *A.* (*Cunearca*) *nux* (Sowerby) and *A.* (*Cunearca*) *aequatorialis* (Orbigny). The same situation as in the species mentioned was found by Heath (1941) in *A.* (*Cunearca*) *chemnitzi* (Philippi) (Pl. 15, fig. 11), a Caribbean species, and in *A.* (*Cunearca*) *perlabiata* (Grant and Gale) (Pl. 14, fig. 6), while *A.* (*Cunearca*) *brasiliana* (Lamarck) = *incongrua* (Say) (Pl. 17, fig. 3), the type of the subgenus *Cunearca,* is different not only in the aspect mentioned, but also in other anatomical structures (Heath, 1941, pp. 304-305). None of these species, as far as I know, have any pigmentation on the mantle margins.

A. (*Scapharca*) *biangulata* (Sowerby) = *gordita* (Lowe), *A.* (*Scapharca*) *cumingiana* (Nyst) = *concinna* (Sowerby), and the Caribbean *A.* (*Scapharca*) *notabilis* (Röding) = *auriculata auct. non* Lamarck, seem to belong to the same group. Perhaps the subgeneric name *Rasia* Gray 1857 (type, *Anadara formosa* (Sowerby), designated by Stewart, 1930) ought to be used for these species. *Anadara baughmani* Hertlein 1951 is also believed to belong to *Rasia.* Among similar shell characters may be mentioned the wide flattened area anterior to the umbones which is not covered with ligament (text-fig. 86). The two species *Anadara biangulata* and *Anadara notabilis* (from Aruba), which are both found in the Hancock collections, have the same arrangement of eye-spots. The soft parts of *Anadara cumingiana* are not at hand, and Heath (1941) does not describe this character in his work. The abdominal sense organs of *A. biangulata* are like those found by Heath (1941) in two species of *Anadara s. s.* Heath also states that the three species of *Scapharca* studied by him, *A. cumingiana, A. notabilis,* and *A. transversa,* have the *Anadara s. s.* type of abdominal sense organs.

The subgenus *Cara* Gray (1857, p. 371, type *Anadara aviculaeformis* (Nyst), designated by Stewart, 1930) is used by Hertlein and Strong (1943) for *Anadara emarginata* (Sowerby). Reinhart (1935) placed *Cara* as a synonym of *Scapharca.* The subgenus should perhaps be

used but its limits seem uncertain. The abdominal sense organs in the two species mentioned above, both of which are represented in the Hancock material, are similar (text-figs. 88-89).

Subgenus **ANADARA** *s. s.*

Anadara (Anadara) tuberculosa (Sowerby) 1833

Pl. 13, figs. 17 a-b

Arca tuberculosa Sowerby, Proc. Zool. Soc. London, 1833, p. 19.
Syn.: ?Arca similis C. B. Adams 1852.
Type loc.: Real Llejos, Nicaragua; mangrove roots.
Holotype: British Museum?
Remarks: Carpenter (1863, p. 364), who had examined the type of *Arca similis* Adams, which has never been figured, considered it doubtfully a variety of *Anadara tuberculosa.* Hertlein and Strong (1943) treat the two as different species and state that they are separable, at least in adult forms. They describe *Anadara similis* as being relatively lower, less angulated at the ends of the dorsal margin, and with the posterior umbonal area less angular than in *Anadara tuberculosa.* They illustrate *A. similis* on Pl. 1, figs. 2 and 5.
Occurrence: Abundant in mangrove swamps in shallow water.
Distribution: Bahía de Ballenas, Baja California, to Tumbes, Peru (Hertlein and Strong, 1943). Olsson (1924) reports it as "very common along the entire coast" (of Peru).

Subgenus **LARKINIA** Reinhart 1935

Larkinia Reinhart, Bul. Brussels Mus. Roy. d'Hist. Nat., vol. 11, 1935, pp. 41-42.
Type of subgenus: Anadara larkinii (Nelson) (Olsson, 1932, Miocene, Peru) orig.

Anadara (Larkinia) grandis (Broderip and Sowerby) 1829

Arca grandis Broderip and Sowerby, Zool. Jour. London, vol. 4, 1829, p. 365.
Fig.: Maury, 1922, Pl. 3, fig. 13; Reinhart, 1943, Pl. 13, figs. 4-6.
Type loc.: Panama Bay (designated by Hertlein and Strong, 1943).
Holotype: British Museum?

Occurrence: Common at Panama and at Central American localities. Often taken at extreme low tide on sandbars (Hertlein and Strong, 1943). Reinhart (1943) reports it from the Pleistocene of Santa Elena Peninsula, Ecuador, and Hanna and Hertlein (1927) from the Pliocene of Carmen Island, Gulf of California. One specimen in the Hancock collection, dead when dredged, is labelled Ensenada, Mexico.
Distribution: Bahía de la Magdalena, Baja California, and Gulf of California, to Brazo Ramon, Peru (5° 47′ S, Frizzell, 1946).

Anadara (Larkinia) multicostata (Sowerby) 1833
Text-figs. 84 a-d

Arca multicostata Sowerby, Proc. Zool. Soc. London, 1833, p. 21.
Fig.: Reinhart, 1943, Pl. 8, figs. 9-11.
Type loc.: Golfo de Tehuantepec, Mexico; 12 fms.
Holotype: British Museum?
Remarks: Young specimens have a faint depression across the umbones; this seems to be a common condition in several species of *Anadara* (*e. g., A. cumingiana, A. biangulata, A. reinharti*). The ribs are furnished with minute pits, three to five in a row across the ribs. Between the rows of pits are faint ridges, which also extend to the interspaces. Every pit has a tiny periostracum flap, while the interspaces have only one larger flap on the same level. On the oldest part of the shell the ribs on the left valve are broader than those on the right. Living specimens have a bright orange-colored flesh (information by Mr. John E. Fitch).
Occurrence: Taken down to 70 fms on various kinds of bottom: rock, sand, coralline, etc. Lives apparently free upon the substratum. All material at hand is either from the Gulf of California or the Galapagos Islands. According to Reinhart (1943, p. 66), its occurrence in the Pliocene of southern California (reported by Arnold, 1907, p. 544, and Eldridge and Arnold, 1907, p. 52), is doubtful.
Distribution: Newport Bay, California, to Panama. The Galapagos Islands. (Hertlein and Strong, 1943.)

Subgenus **SCAPHARCA** Gray 1847

Scapharca Gray, Proc. Zool. Soc. London, 1847, p. 198.
Type of subgenus: Arca inaequivalvis Bruguière 1789 (orig.).

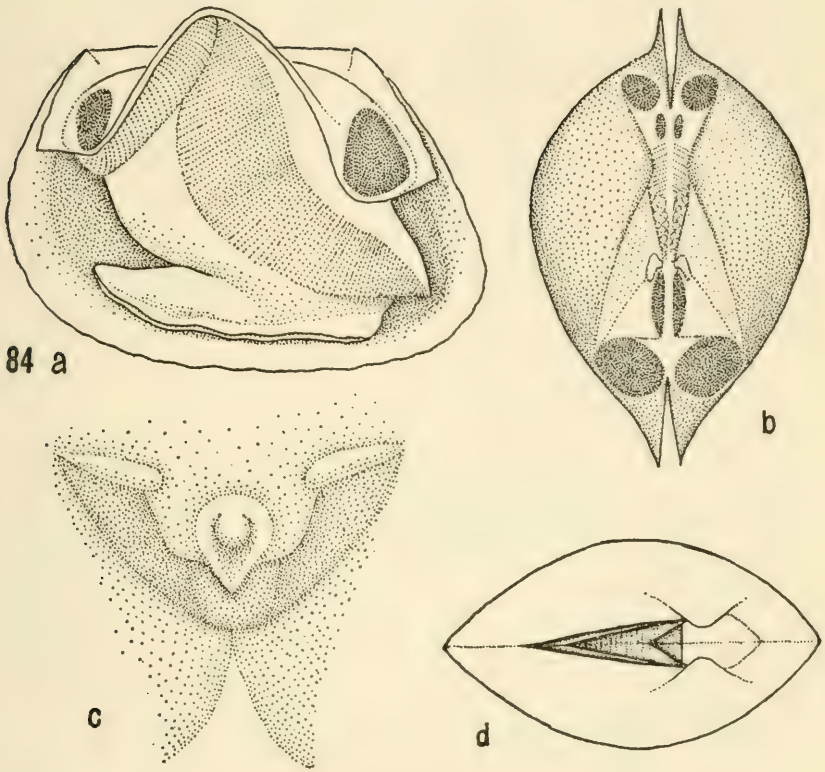

Fig. 84. *Anadara* (*Larkinia*) *multicostata* (Sowerby) 1833. South of Isla Tiburón, Gulf af California. a. Lateral view. b. Dorsal view. c. Abdominal sense organs. Length, 62.8 mm. d. Bahía San Francisquito, Gulf of California. Dorsal view showing arrangement of ligament of young specimen. Length, 13.8 mm.

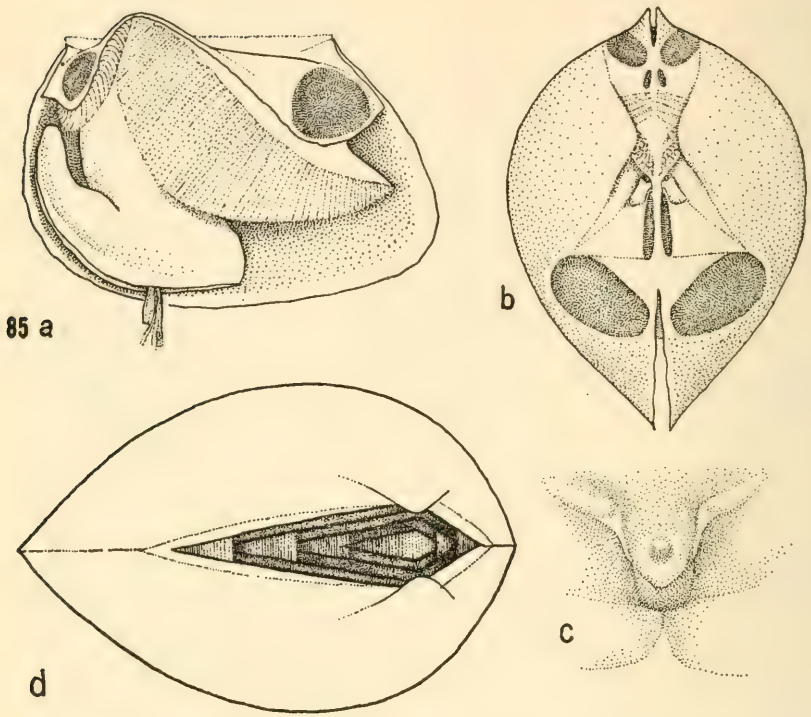

Fig. 85. *Anadara* (*Scapharca*) *reinharti* (Lowe) 1935. Puerto Escondido, Gulf of California. a. Lateral view. b. Dorsal view. c. Abdominal sense organs. Length, 23 mm. d. Off Isla de la Nuez, Isla del Coco, Costa Rica. Dorsal view showing arrangement of ligament. Length, 40.4 mm.

Anadara (Scapharca) reinharti (Lowe) 1935

Pl. 13, figs. 18 a-c, 19 a-b; Pl. 14, figs. 20 a-c; text-figs. 85 a-d

Arca (*Anadara*) *reinharti* Lowe, Trans. San Diego Soc. Nat. Hist., vol. 8, no. 6, pp. 16-17, Pl. 1, figs. 3 a-c.

Type loc.: Guaymas, Sonora, Mexico; 20 fms.

Holotype: San Diego Natural History Museum. Type coll. cat. no. 11389.

Remarks: Although this species was rather recently described, it seems to be common. Previously it has supposedly been confused with *Anadara* (*Larkinia*) *multicostata* (Sowerby). The subgeneric placement of *Anadara reinharti* is questionable. Small specimens are more like *Cunearca,* while very large ones are close to the *Larkinia* group. Reinhart (1943) referred it to *Scapharca,* a placement followed here, though it is not satisfactory. The specimens here referred to *A. reinharti* are rather variable, a circumstance not common in the genus *Anadara,* although some variation in this species has previously been pointed out (Hertlein and Strong, 1943, p. 157). Possibly the group should be divided into several species, but more knowledge of it will be necessary before this can be done. Only small specimens were hitherto reported under the name *A. reinharti;* thus we find that the type, which was about the largest specimen reported, has a length of only 27.7 mm. However, the present material includes samples with much larger specimens (about 40 mm), one sample (773-38) containing 32 large specimens, the largest of which measures 45.5 mm in length, 40.4 mm in height, and 37.7 mm in diameter. The whole sample is preserved in alcohol. One very large specimen (Pl. 13, fig. 19), referred somewhat doubtfully to *A. reinharti,* measures 75 mm in length, 58.5 mm in height, and 59.5 mm in diameter; and has 31 ribs. The usual number of ribs in this species varies between 26 and 29. The ribs on the left valve are nodulose on the anterior and middle part on young shells and also on the anterior part of the right valve. On older shells, the ribs become grooved, especially on the left valve. Two to four grooves on the ribs may be observed. The ribs on the left valve are broader than those on the right and the interspaces are furnished with thin transverse ridges. In some specimens the ribs may be smoother, and the breadth is also variable. They are furnished with small pits as in *A. multicostata.* In small specimens a faint groove or depression may be seen on the umbones. This groove is sometimes colored with reddish-brown, and appears as a colored line across the umbones. Other parts of the shell are sometimes stained with reddish-brown also.

A concavity on the posterodorsal margin distinguishes it from *Anadara* (*Larkinia*) *multicostata,* and there is a slight convexity on the posterior part of the ventral margin. Young *A. reinharti* is also more elongate than *A. multicostata* and has a larger number of chevron-shaped grooves on the ligament than has the latter species. A specimen of *A.*

reinharti with a length of 21 mm has three grooves, and a specimen 43.5 mm long has six; while a specimen of *A. multicostata* with a length of 75 mm has three grooves, and a specimen with a length of 53 mm has only one groove. The large specimen which, as previously mentioned, was with doubt referred to *A. reinharti,* has six grooves on the ligament. It may be seen that the number of ribs cannot be used to distinguish the two species with certainty, since this number slightly overlaps. The character may, however, be used as an aid to identification.

As pointed out by Lowe (1935, p. 16), *Anadara reinharti* is more inflated than *Anadara multicostata.* The D/L ratio of *A. reinharti* in the present material varies between 66% and 87%. The same ratio in the holotype is 88.5%; for its size, the type is exceptionally inflated. Small specimens have the lowest D/L ratio. One tiny eye-spot may be observed on the anterior end of each mantle margin in some specimens; it is not easily observed and does not seem to be a constant character. The foot is furnished with a threadlike byssus which was intact in many of the specimens examined. In some small specimens (5 to 10 mm), pebbles were attached to the byssus.

Occurrence: This species was taken from 1 to 50 fms, on various kinds of bottom, sand, shells, rock, mud, etc. Previously (Hertlein and Strong, 1943), it was known from the Gulf of California to Panama. Two samples in this collection are from Ecuador.

Distribution: Punta Peñasco, Sonora, Gulf of California, to Bahía de Santa Elena, Ecuador.

Anadara (Scapharca) cumingiana (Nyst) 1848

Arca cumingiana Nyst, Mém. Acad. Roy. Sci. Belgique, vol. 22, p. 22, new name for *Arca concinna* Sowerby 1833, P. Z. S. L., p. 20 (not *Cucullaea concinna* Phillips 1829).

Fig.: Maury, 1922, Pl. 1, fig. 10.

Anatomy: Heath, 1941.

Type loc.: Golfo de Nicoya, Costa Rica; 12 fms; coarse sand.

Holotype: British Museum?

Remarks: Unfortunately the specific name *cumingiana* has to replace *concinna* (Sowerby), according to the International Rules of Zoological Nomenclature (see Reinhart, 1943, p. 73, footnote).

A good description of this species is given by Maury (1922, p. 25). The ligamental area is similar to that of *Anadara biangulata* (Sowerby) = *gordita* (Lowe), a species to which it seems to be related. The chevron-shaped ligament grooves are few (one to three) in relation to

age, and in a specimen 29.8 mm long, one groove reached before the umbo. Sometimes the shell is stained with light reddish-brown, especially on the umbones. The periostracum is bristly in the interspaces between the anterior and posterior ribs, but shell-like in the median part. The posterior and anterior rows of teeth overlap. Maury (1922) reports a specimen with a length of 35 mm, which seems to be the maximum recorded length of this species. *Anadara cumingiana* should possibly be referred to the subgenus *Rasia* Gray.

Occurrence: A. cumingiana is taken from 5 to 50 fms, although it commonly occurs deeper than 20 fms. Sand, mud, or sandy mud are the common components of the bottom in which it lives. The Allan Hancock material extends the distribution south to Isla Salango, Ecuador.

Distribution: Bahía de San Luis Gonzaga, west coast of Gulf of California (29° 50′ N), to Isla Salango, Ecuador.

Anadara (Scapharca) biangulata (Sowerby) 1833

Text-figs. 86, 87 a-c

Arca biangulata Sowerby, Proc. Zool. Soc. London, 1833, p. 21.

Syn.: ?Arca gordita Lowe 1935.

Fig.: Lowe, 1935, Pl. 1, fig. 1; Reinhart, 1943, Pl. 12, figs. 10-11.

Type loc.: Atacames, Ecuador; 7 fms.

Holotype: British Museum?

Remarks: It is very probable that *Anadara biangulata* and *Arca gordita* represent the same species; they were so considered by Hertlein and Strong (1943). Sowerby's description is short and an illustration of the type was not given. Sowerby, who had a single specimen, described it among the equivalves. A complete specimen in this collection, which measures 25.6 mm, is very distinctly inequivalve, with the left valve overlapping the right ventrally. Reinhart (1943) placed *Anadara gordita* in *Anadara s. s.* because of the similar sculpture on both valves.

Two V-shaped ligamental grooves are present behind the umbones in a specimen 25.6 mm long, as shown in text-fig. 86. The stippled area is covered with ligament, and the elastic bands across the V-shaped areas are indicated. The rows of teeth overlap as in *Anadara concinna.* The sculpture in the interspaces between the ribs is also similar in the two species. The figure by Reinhart (1943) gives a very good picture of the sculpture. Small specimens are more elongate in shape than larger ones.

This species should probably be referred to subgenus *Rasia* Gray.

Occurrence: Hertlein and Strong (1943) report it from 12 to 61 fms. Muddy bottom is most common, also sand, crushed shells, etc. The only

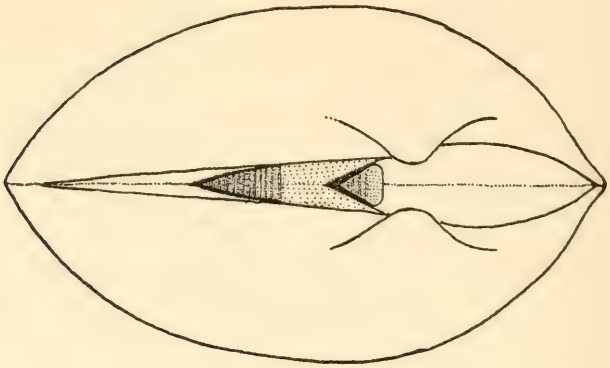

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Fig. 86. *Anadara* (*Scapharca*) *biangulata* (Sowerby) 1833. Isla Isabel, Gulf of California. Dorsal view showing the arrangement of the ligament. Length, 25.6 mm.

specimen dredged alive in this collection is from Isla Isabel, Mexico, 10 to 15 fms.

Distribution: San Felipe, east coast of Baja California (Gulf of California), to Payta, Peru. The Galapagos Islands. (The two latter localities are taken from Hertlein and Strong, 1943.)

Anadara (Scapharca) aviculaeformis (Nyst) 1848

Pl. 14, figs. 21 a-c, 23; text-figs. 88 a-c

Arca aviculaeformis Nyst, Mém. Acad. Roy. Sci. Belgique, vol. 22, 1848, p. 12.

Syn.: Arca auriculata Sowerby 1833 (not Lamarck 1819).

Arca aviculoides Reeve 1844 (not de Koninck 1842).

Type loc.: Santa Elena, Ecuador; 10 fms; mud.

Holotype: British Museum?

Remarks: There seem to be few records of this species. Apparently *Anadara biangulata* (Sowerby) has often been given this name. Cuming collected the type described by Sowerby, which measured 30 mm. C. B. Adams (1852) gives a record of one specimen of *Arca aviculoides* from Panama, but says the specimen was too young to be determined with confidence. Dall (1909) gives its range as from Panama to Guayaquil. Maury (1922) reports one specimen from Panama (Newcomb collection), with a length of 23 mm. Two specimens are present in the Allan

Hancock collections. The larger one, from Isla Isabel, Mexico, measures 54.5 mm in length, 31.7 mm in height, and 27.4 mm in diameter. It fits Reeve's description very closely and must represent this species, despite its much larger size and more northerly locality. The other specimen, from Islas Secas, Panama, measures 34.6 mm in length, 21.2 mm in height, and 18.3 mm in diameter, and agrees completely with the larger example. One specimen in the San Diego Museum of Natural History (cat. no. 28182) is labelled "Carmen Island, Gulf of California, 20 fms." Its length is 27 mm and it agrees completely with the specimens at hand. The shells possess 37 to 39 ribs. The periostracum is dark brown and bristly in the interspaces between the ribs. Posteriorly the bristles become very long but are still soft. On the ribs the periostracum forms membranous lamellae which are of a lighter color. The ligament has two chevron-shaped grooves. Between one third and one fourth of the ligament is situated anterior to the umbones. A black ray on the umbones as described by Maury (1922) cannot be observed. This species was designated by Stewart (1930) as the type of the subgenus *Cara* Gray.

Occurrence: Rare. Taken between 10 and 20 fms, on various kinds of bottom, sand, mud, rock, coralline, etc.

Distribution: Isla del Carmen, west coast of the Gulf of California (San Diego Museum), to Santa Elena, Ecuador.

Anadara (Scapharca) emarginata (Sowerby) 1833

Pl. 14, fig. 22; text-figs. 89 a-c

Arca emarginata Sowerby, Proc. Zool. Soc. London, 1833, p. 20.

Fig.: Reeve, 1844, Pl. 4, fig. 26; Maury, 1922, Pl. 2, figs. 5, 10.

Type loc.: Atacames, Ecuador (designated by Hertlein and Strong, 1943).

Holotype: British Museum?

Remarks: The material at hand contains only small specimens less than 18 mm in length. The umbones are decorated with a blue, bluish-green, or black radiating ray, and the rest of the shell has black blotches. Sometimes black lines radiating from the umbo are present in the interior of the shell (cfr. Carpenter, 1856a, p. 137). The ribs are about 30 in number. The five or six most anterior and three or four most posterior ribs are often crossed by transverse ridges. The posterior auriculation is variably pronounced. The byssus is well developed and intact in some of the specimens. The mantle margin is pigmented with a dark brown

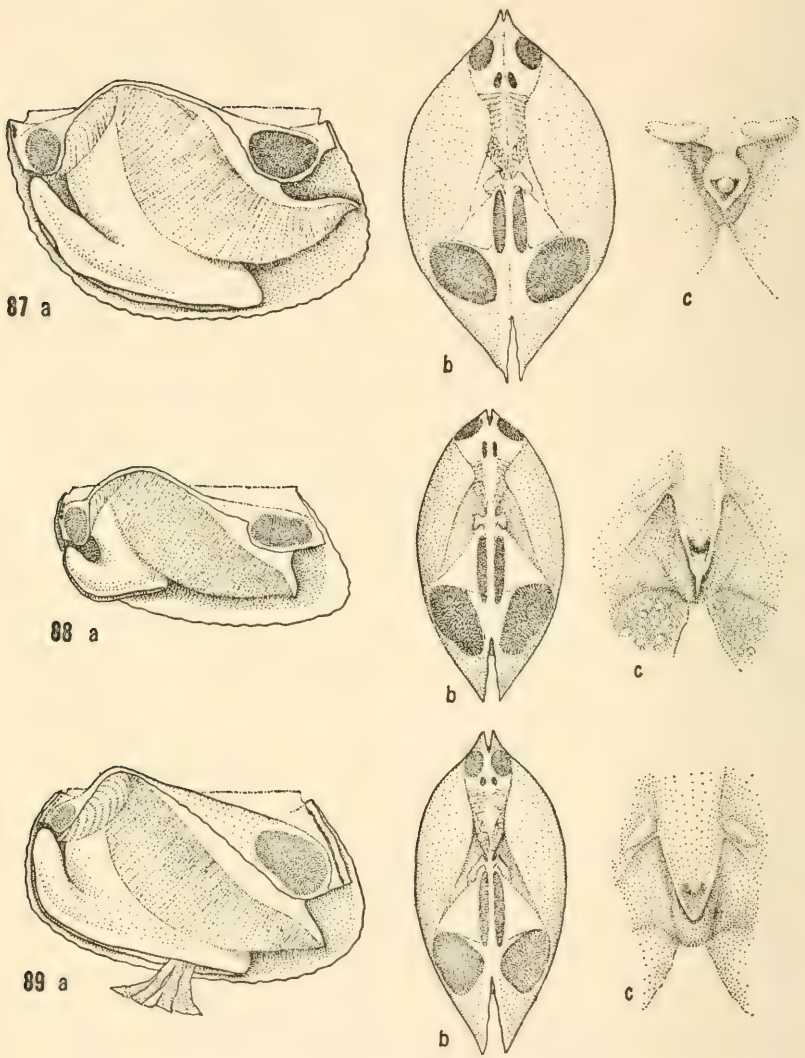


Fig. 87. *Anadara* (*Scapharca*) *biangulata* (Sowerby) 1833. Isla Isabel, Gulf of California. a. Lateral view. b. Dorsal view. c. Abdominal sense organs. Length, 25.6 mm.

Fig. 88. *A.* (*Scapharca*) *aviculaeformis* (Nyst) 1848. Isla Isabel, Gulf of California. a. Lateral view. b. Dorsal view. c. Abdominal sense organs. Length, 54.5 mm.

Fig. 89. *A.* (*Scapharca*) *emarginata* (Sowerby) 1833. Canal de Marcy, Bahía de la Magdalena, Baja California. a. Lateral view. b. Dorsal view. c. Abdominal sense organs. Length, 14.8 mm.

irregular band on the side that touches the shell. No eye-spots can be distinguished with certainty. Maury (1922) reports a specimen with a length of 48 mm. This species should perhaps be referred to the subgenus *Cara* Gray.

Occurrence: This species is recorded from 3 to 13 fms. It is dredged from sand, sandy mud, and rocky bottom. Carpenter (1856a) reports young specimens on *Spondylus* and adults on *Murex*. It is known to occur from the Gulf of California to Atacames, Ecuador. Hertlein and Strong (1943) say it occurs in the Pleistocene in Magdalena Bay, Lower California. Four living specimens from Bahía de la Magdalena are present in this material.

Distribution: Bahía de la Magdalena, Baja California, and Gulf of California, to Payta, Peru (reported by Olsson, 1924).

Anadara (Scapharca) obesa (Sowerby) 1833

Pl. 16, figs. 28 a-b; text-figs. 90 a-c

Arca obesa Sowerby, Proc. Zool. Soc. London, 1833, p. 21.
Type loc.: Atacames, Ecuador; 7 fms.
Holotype: British Museum?

Remarks: This species can scarcely be confused with other west American Anadaras because of its great number of ribs (39 to 44). It attains a length of 40 mm (Maury, 1922). As shown on text-fig. 90 c, the abdominal sense organs of this species are of the same type as those of *Anadara* (*Cunearca*) *nux* (Sowerby) and *Anadara* (*Cunearca*) *aequatorialis* (Orbigny).

Occurrence: Not common. Taken in fine sand or mud from 12 to 61 fms.

Distribution: Off San Jose del Cabo, south coast of Baja California, to Negritos, Peru (Hertlein and Strong, 1943).

Subgenus CUNEARCA Dall 1898

Cunearca Dall, Trans. Wagner Free Inst. Sci., vol. 3, part 4, 1898, p. 618.
Type of subgenus: Arca incongrua Say 1822 (orig.).

Anadara (Cunearca) nux (Sowerby) 1833

Pl. 16, figs. 29 a-c; text-figs. 91 a-c

Arca nux Sowerby, Proc. Zool. Soc. London, 1833, p. 19.
Type loc.: Jipijapa, Ecuador; 12 fms; sandy mud.
Holotype: British Museum?

Remarks: One V-shaped groove circumscribes the ligamental area. On larger specimens a second groove may be developed, though it does not become definitely V-shaped. The ligamental area is crossed by elastic bands which are usually worn off in the middle part. If a second groove is developed, a secondary layer of elastic bands will also be present. In small specimens, the ligament is posterior to the umbones only. The anterior groove grows rapidly, however, and finally the umbones are only slightly anterior to the center of the ligamental area. The periostracum is bristly in the interspaces, the bristles becoming long and thin on the posterior slope. The mantle margin is unpigmented. The abdominal sense organs are similar to those of *Anadara* (*Cunearca*) *chemnitzi* and *Anadara* (*Cunearca*) *perlabiata* (Heath, 1941, Pl. 15, fig. 11; Pl. 14, fig. 6), with a trilobate flap above the anal opening. A papilla in the opening is sometimes visible.

Anadara (*Cunearca*) *nux* may attain a length of 25 mm (Maury, 1922).

Occurrence: Dredged from 2 to 40 fms. The larger part of the material at hand taken between 10 and 20 fms. Lives in bottom of fine sand or mud.

Distribution: Bahía Concepción, east coast of Baja California (Hertlein and Strong, 1943) to Negritos, Peru (Olsson, 1924).

Anadara (Cunearca) aequatorialis (Orbigny) 1846

Pl. 15, figs. 27 a-c; text-figs. 92 a-c

Arca aequatorialis Orbigny, Voyage dans l'Amérique Méridionale, vol. 5, pt. 3, p. 636; new name for *Arca ovata* Reeve 1844, not *Arca ovata* Gmelin in Linné 1791; not *Arca ovata* Buckman in Murchison 1844.

Syn.: Arca subelongata Nyst 1848, new name for *Arca ovata* Reeve.

Type loc.: Santa Elena, Ecuador; 6 to 8 fms; sandy mud.

Holotype: British Museum?

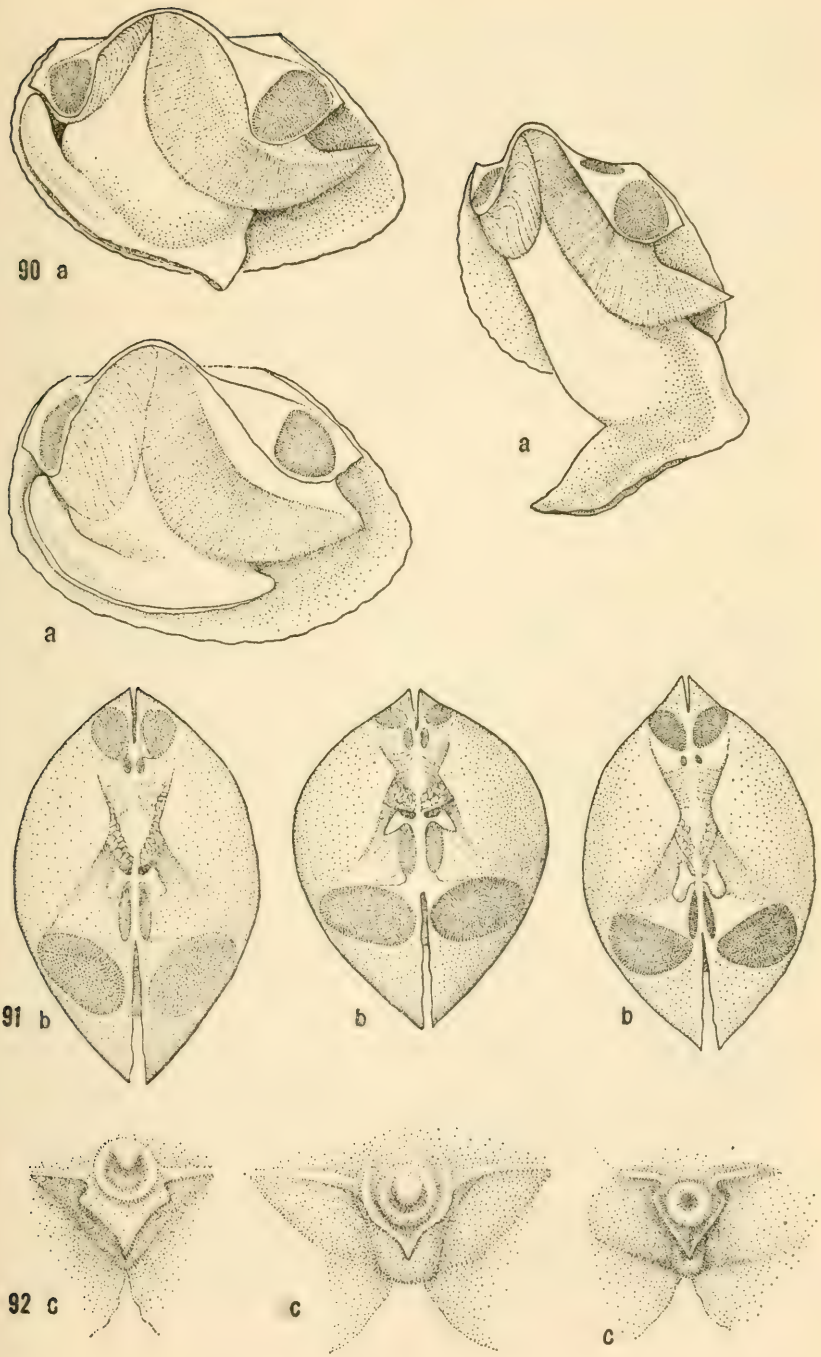
Occurrence: In fine sand or mud, from 7 to 40 fms.

Distribution: Mazatlán, Mexico, to Zorritos, Peru. The Galapagos Islands. (Hertlein and Strong, 1943).

Fig. 90. *Anadara* (*Scapharca*) *obesa* (Sowerby) 1833. Off San José, Guatemala. a. Lateral view. b. Dorsal view. c. Abdominal sense organs. Length, 25.7 mm.

Fig. 91. *A.* (*Cunearca*) *nux* (Sowerby) 1833. Off San José, Guatemala. a. Lateral view. b. Dorsal view. c. Abdominal sense organs. Length, 15.5 mm.

Fig. 92. *A.* (*Cunearca*) *aequatorialis* (Orbigny) 1846. Off San José Guatemala. a. Lateral view. b. Dorsal view. c. Abdominal sense organs. Length, 14 mm.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a
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91 b
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92 c
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Genus **LUNARCA** Gray 1842

Lunarca Gray, Synopsis of the Contents of the British Museum, ed. 44, 1842, p. 81.

Syn.: Argina Gray 1840 (*nomen nudum*).
Argina Gray 1842 (*non* Hübner 1822).
Arginarca McLean 1951 (new name for *Argina* Gray).

Type of genus: Lunarca costata Gray 1842 (by monotypy) = *ovalis* (Bruguière) 1892 = *campechiensis* (Gmelin) 1791 =*pexata* (Say) 1822 = *americana* (Wood) 1828, etc.

Remarks: The anterior teeth are irregular and have a tendency to grow together in larger specimens, and a groove may be formed in the opposite valve for the reception of these confluent teeth. Gray's specimen, upon which *Lunarca* was based, is probably an extreme case in which the anterior teeth had grown together as one. There can scarcely be any doubt that *Lunarca costata,* known from only one specimen, is the same as *Lunarca ovalis* (Bruguière) (see figures given by H. and A. Adams (1857), Pl. 125, figs. 7, 7a, *L. pexata* (Say); *L. costata* Gray, figs. 8, 8a)

Four species belonging to this group are described from the west coast of America. They are: *Lunarca brevifrons* (Sowerby) 1833, *Lunarca vespertina* (Mörch) 1861, *Lunarca brevifrons bucaruana* (Sheldon and Maury) in Maury, 1922 (described as a variety of *L. brevifrons*), and *Lunarca melanoderma* (Pilsbry and Lowe) 1932. However, none of these species seem to be clearly circumscribed; the number of ribs has mainly been used to identify them. *Lunarca brevifrons* seems to have been reported only two times; from Tumbes, Peru, where the type specimen was found, and from Mazatlán, Mexico, from which locality Carpenter (1856a) reported it in the Reigen Catalogue, with a question as to its identity. Maury (1922) and Hertlein and Strong (1943) say that *L. brevifrons* is distinguished by having only 22 or 23 ribs, while the other species of the group have more than 30. Sowerby (1833) gives no number of ribs in the description of the type; but Reeve (1843) gives the number as 22 or 23 in his description of *L. brevifrons.* However, as his figure of this species seems to have far more than 22 or 23 ribs, his recording may perhaps be an error for 32 or 33. An examination of the type material is necessary to settle this question.

The status of the three other species is also questionable. Hertlein and Strong (1943) suggested that *L. melanoderma* might be the same as *L. brevifrons bucaruana. L. vespertina* (Mörch) is described from

one single broken valve 7.75 mm in length, from Realejo, Nicaragua. Three samples of small specimens from Baja California and the Gulf of California are here referred to *L. vespertina* (Mörch), as his description fits them very closely. One sample from Panama and two from the Galapagos Islands are referred to *Lunarca* sp.

It is quite possible that all *Lunarca* from the west coast is one variable species similar to *Lunarca ovalis* from the east coast. A large amount of material from many localities is needed before further conclusions can be drawn.

Lunarca vespertina (Mörch) 1861

Pl. 15, figs. 24 a-b; text-figs. 93 a-c

Arca (*Argina*) *vespertina* Mörch, Malakozool. Blätter, vol. 7, 1861, p. 204.

Fig.: Hertlein and Strong, 1943, Pl. 1, figs. 6-7.

Type loc.: Realejo, Nicaragua.

Holotype: ?

Remarks: The west American species belonging to this genus are discussed in the previous section under the genus *Lunarca.*

Four specimens are here referred to *Lunarca vespertina.* They are all small and fit Mörch's description very closely. The only figure of this species in existence is given by Hertlein and Strong (1943, Pl. 1, figs. 6-7) and the rather large specimen figured, 36.1 mm in length, does not strongly resemble the shells referred to the same species in the material at hand. The authors state, however, that larger specimens become more elongate, while the younger ones are more quadrate in shape.

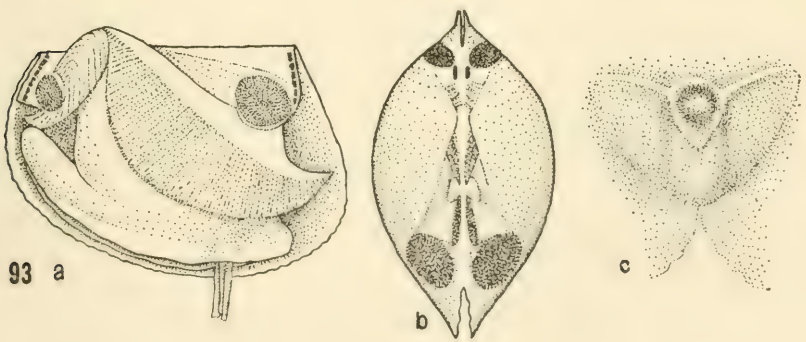

Fig. 93. *Lunarca vespertina* (Mörch) 1861. Off Punta Pequeña, Baja California. a. Lateral view. b. Dorsal view. c. Abdominal sense organs. Length, 17.5 mm.

The number of ribs varies between 36 and 38, and the ribs of the left valve are broader than those on the right. The umbones are stained with bluish-black. The mantle margin has a heavily pigmented narrow band on the side that touches the shell, but no distinct eye-spots can be observed. The byssus was found intact in two of the specimens and consists of thin threads. Heath (1941, p. 305) did not find any sign of a byssus in *Lunarca ovalis* (Bruguière)=*pexata* (Say), the Atlantic coast species. The abdominal sense organs of *L. vespertina* resemble those of this species. The labial palps are comparatively smaller in *L. ovalis*. It may be noted, however, that the specimens examined by Heath had a length of 52 mm. The largest specimen of *L. vespertina* in the present material measures 17.2 mm in length, 12.8 mm in height, and 9.6 mm in diameter. It is from off Punta Pequeña, Baja California (617-37).

Occurrence: One of the samples was collected in shallow water, while the other two were both dredged from 24 fms, in sand and sandy mud respectively. Hertlein and Strong (1943) report it from 7 to 13 fms with sand, mangrove leaves.

Distribution: Off Punta Pequeña, west coast of Baja California, Isla Espiritu Santo, Gulf of California (the present material), Mazatlán, Mexico, Corinto, Nicaragua (Hertlein and Strong, 1943). Dall and Ochsner (1928) report it with a question mark as fossil from the Galapagos Islands. This identification, however, is in error (Reinhart, 1943).

Lunarca sp.

Pl. 15, figs. 25 a-b, 26

Remarks: As mentioned before, three samples are here referred to *Lunarca* sp. One from the Galapagos Islands consists of a worn right valve which measures 45.7 mm in length, 35.6 mm in height, and 14.8 mm in semidiameter, and possesses 35 ribs. The other Galapagos valve (left) measures 43.6 mm in length, 33.2 mm in height, and 15 mm in semidiameter; and has 36 ribs. Another sample is from Panama and consists of a complete specimen which measures 52 mm in length, 41.3 mm in height, and 35.5 mm in diameter. The specimen is thick, with swollen umbones, and has 36 ribs. The left valve overlaps the right except anterodorsally and posterodorsally.

Subfamily **Noetiinae** Stewart 1930

Remarks: Stewart (1930) placed this subfamily in the family Glycymeridae. MacNeil (1938) raised it to family rank under the superfamily Glycymeracea. To Noetiidae he referred the subfamilies Stri-

arcinae, Trinacriinae, and Noetiinae. This arrangement is not used in the present paper (see discussion by Reinhart, 1943, pp. 5 and 76). Frizzell (1946) also gave the subfamily family rank, but retained it in the superfamily Arcacea.

Genus **NOETIA** Gray 1857

Noetia Gray, Ann. and Mag. Nat. Hist., ser. 2, vol. 19, 1857, p. 371.
Type of genus: Noetia triangularis Gray 1857 (by monotypy) = *reversa* (Sowerby), *fide* Reinhart, 1935.

Subgenus **NOETIA** *s. s.*

Noetia (Noetia) reversa (Sowerby) 1833

Text-figs. 94 a-c

Arca reversa Sowerby, Proc. Zool. Soc. London, 1833, p. 20.
Syn.: Noetia triangularis Gray 1857.
Fig.: Reinhart, 1943, Pl. 14, figs. 5, 7, 8.
Type loc.: Tumbes, Peru; 7 fms; soft mud.
Holotype: British Museum?
Remarks: The general external appearance of the anatomy of this species resembles that of *Noetia ponderosa* (Say), which has been studied by Heath (1941; general appearance, Pl. 18, fig. 1). In *Noetia reversa,* the labial palps are relatively larger. Besides having two large anal papillae placed as in *N. ponderosa* (Heath, 1941, Pl. 19, fig. 2), *N. reversa* has a papilla or flap (not always visible) in the opening of the anus. The mantle margin is unpigmented. The teeth are striated on both sides but the top is smooth.
Occurrence: Noetia reversa was dredged by the *Velero III* and *Velero IV* in depths down to 24 fms, on sandy or muddy bottom. Hertlein and Strong (1943) report it down to 40 fms. Reinhart (1943) gives its habitat as intertidal.
Distribution: Off Bahía Concepción, Gulf of California, to Peru.

Genus **SHELDONELLA** Maury 1917

Sheldonella Maury, Bul. Amer. Paleontology, vol. 5, no. 29, 1917, p. 166.
Type of genus: Noetia (*Sheldonella*) *maoica* Maury (by monotypy); Miocene, Dominican Republic.

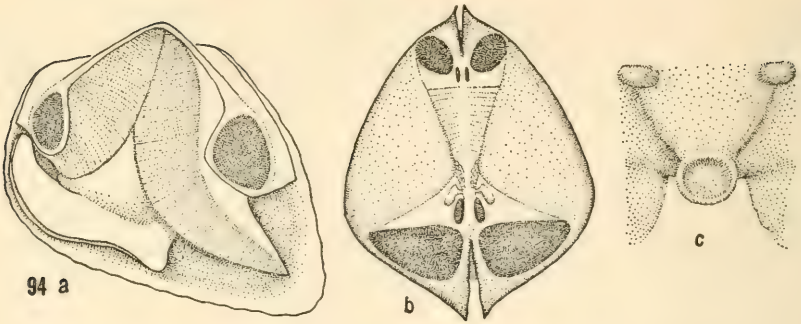

Fig. 94. *Noetia reversa* (Sowerby) 1833. Off Acapulco, Mexico. a. Lateral view. b. Dorsal view. c. Abdominal sense organs. Length, 17.5 mm.

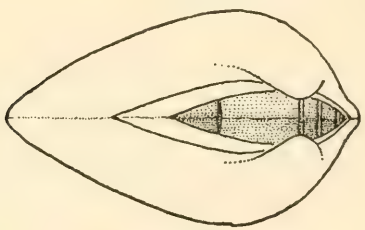

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Fig. 95. *Sheldonella delgada* (Lowe) 1935. South of islands off Navidad Head, Bahía Tenacatita, Mexico. Dorsal view showing the arrangement of the ligament. Length, 14.8 mm.

Sheldonella delgada (Lowe) 1935

Text-fig. 95

Arca delgada Lowe, Trans. San Diego Soc. Nat. Hist., vol. 8, no. 6, p. 16, Pl. 1, fig. 2.

Fig.: Reinhart, 1943, Pl. 12, figs. 4-5.

Type loc.: Manzanillo, Mexico; 20 fms.

Holotype: San Diego Museum of Natural History. Type coll. cat. no. 11388.

Remarks: The arrangement of the ligamental area is shown in a sketch, text-figure 95. The specimen figured has a length of 14.8 mm. The posterior groove on the ligament which, according to MacNeil (1937, p. 7), has not been observed in *Sheldonella,* is distinct, though less

prominent than the three anterior ones, and does not reach quite across the area covered with ligament. Another specimen, with a length of 15.7 mm, has four anterior grooves, but a distinct posterior groove is lacking. One valve is stained with reddish-brown posteriorly and the interior of the umbonal cavity is also reddish-brown. One of the specimens was alive when dredged, but unfortunately it was not preserved in alcohol and the animal was dried up and badly cracked. Though soaking in trisodiumphosphate was tried, a restoration of the animal was impossible. In this specimen a relatively deep byssal cavity seems to be present. The labial palps are short and broad. The gills are elongate and apparently placed more horizontally than in *Noetia* (*Noetia*) *reversa* and *Noetia* (*Eontia*) *ponderosa,* as one would expect from the form of the shell.

Occurrence: This species was previously reported only from the type locality, Manzanillo, Mexico, where it was collected at 20 fms by Lowe in 1930. Hertlein and Strong (1943) report it also from Manzanillo, at 30 fms in gravelly sand. By the Allan Hancock Foundation, it has been dredged at four stations from Bahía de San Ignacio, Sinaloa, Mexico, to Bahía Honda, Panama. In the California Academy of Sciences, there are specimens from Chamela Bay, Mexico, 15 to 40 fms, and from near Santa Isabel Island, Gulf of California (T. Crocker Expedition, 1932).

Distribution: Bahía de San Ignacio, Sinaloa, Mexico, to Bahía Honda, Panama.

LIST OF MATERIAL OF THE FAMILY ARCIDAE PRESERVED IN THE ALLAN HANCOCK FOUNDATION COLLECTIONS

The list of stations under each species is arranged as correctly as possible from north to south, after the records at hand. Place names are given as listed in the Millionth Map of Hispanic America, American Geographical Society. Alternative names for stations occupied by the *Velero III* from 1931 to 1942 will be found in the Allan Hancock Pacific Expeditions, Volume 1, number 3. The numbers marked BS are mud sample stations taken separately, and alternative names for these will be found in the Allan Hancock Pacific Expeditions, volume 6. Other numbers represent stations at which collections were made by members of the Allan Hancock Foundation staff, or by others.

The stations lying within a line from Cabo San Lucas, Baja California, and Cabo Corrientes, Jalisco, Mexico, are recorded as from the Gulf of California.

Station	Location	Depth	Remarks	Specimens
ARCA (ARCA) PACIFICA (SOWERBY)				
California				
1271-41	¾ mi SE of Cat Rock, Anacapa Island			one and one valve (dead). Ballast?
Mexico: Gulf of California				
1051-40	Puerto Refugio, Isla Angel de la Guarda	21 fms	Shell	three and three valves
1048-40	Puerto Refugio, Isla Angel de la Guarda	11-22 fms	Shell, sand	many
1056-40	Puerto Refugio, Isla Angel de la Guarda	6-11 fms	Sand, coralline	one
555-36	Between Isla Partida and Isla Angel de la Guarda	20 fms	Nullipores	two
BS 275	Isla Raza	40 fms		one valve
1044-40	S of Isla Tiburón	2-16 fms	Sand. Beam trawl	fourteen
BS 276	Isla de San Esteban	32 fms		one valve
1516-46	Ensenada de San Francisco, Sonora	Reefs		one valve
1039-40	Bahía de Guaymas, near Cabo Haro, Sonora	6-10 fms	Shell, mud	one
580-36	SE of Isla San Marcos	20 fms	Nullipores	one
689-37	Bahía del Coyote, Bahía Concepción	Shore	Sand, rock	two
1095-40	Puerto Escondido, S of Loreto	1-2 fms	Dipnetting	two
1093-40	Puerto Escondido, S of Loreto	8-15 fms	Sand, sponge, coral	one and one valve
594-36	Puerto Escondido, S of Loreto	10-15 fms	Sand, seaweed	one
592-36	Puerto Escondido, S of Loreto	24 fms	Mud, shell	one
742-37	Bahía de San Ignacio	30-50 fms	Shell	eleven
606-36	Canal de San Lorenzo	14 fms	Sand	one
Panama				
457-35	Islas Secas	12 fms	Sand, rock	three
863-38	Off Isla Medidor, Bahía Honda	30-50 fms	Rock, sand, mud	one
948-39	Off Isla Medidor, Bahía Honda	30-35 fms	Rock, mud, coralline	many large
246-34	Bahía Honda	Rocky reef		one and one valve
Ecuador				
850-38	Off Cabo de San Francisco	15 fms	Mud, rock	one
399-35	Isla Salango	8 fms	Sand	one
209-34	Off La Puntilla	8-10 fms	Rock, gorgonids	one valve
BS 504	Bahía de Santa Elena, off Salinas	25 fms		one valve

ARCA (ARCA) MUTABILIS (SOWERBY)

Mexico: Gulf of California				
1049-40	Puerto Refugio, Isla Angel de la Guarda	Shore	Rocky reef	one
1767-49	Vicinity of Puerto San Carlos, Sonora	Shore	Rocky beach	two
1092-40	Bahía Catalina, near Cabo Haro, Sonora	Shore	Shingle	one
601-36	Bahía de Agua Verde	20 fms	Mud	one
1734-49	Los Frailes	Shore	Rocky beach, tide pools	nine
2588-54	Isla Isabel	0-3 fms	Rock	thirty two
749-37	Isla Isabel	Rocky reef	Low tide	many
125-33	Isla Isabel	Shallow water	*Porites* coral	one
124-33	Isla Isabel	Shore	Rock	thirty
972-39	Isla María Magdalena, Las Tres Marías	Shore	Rock	seven
2601-54	Lagoon behind NE Point, Isla María Cleofas, Las Tres Marías	Shore	Loose rock, sand	three
Mexico				
2600-54	North side, Bahía Tenacatita, Jalisco	0-4 fms	Rock	five
2-31	Bahía Tenacatita			one
131-34	Bahía Braithwaite, Isla Socorro	Shallow water	*Pocillopora* coral	one
130-34	Bahía Braithwaite, Isla Socorro	Shore	Rock, large shingle, tide pools	three
2591-54	Rocas de San Lorenzo, Acapulco, Guerrero	0-2 fms	Rock	two
Costa Rica				
465-35	Bahía Playa Blanca	Shore	Shale	ten
466-35	Puerto Parker, opposite Punta Abajo	Shore	Small island at entrance. Rock	twenty six
253-34	Boca de Culebra	10 fms	Mud. shell	one valve
256-34	S of Punta Mala	Shore	Rock	nine
258-34	Off Bahía Cocos	Shallow water	Coral	one
Panama				
957-39	Isla Taboga	Shore	Rock, tide pools	one
866-38	Islas Secas	Shore	Rock	two
446-35	Islas Secas	Shore	Rock	four
436-35	Puerto Piñas	Shore	Rock	two
241-34	Off Isla Jicarita	15 fms	Rough rock	four
243-34	Isla Jicarita	Shore	Rock	one
Colombia				
433-35	Bahía Octavia	Shore, on island	Shingle	twenty one

Station	Location	Depth	Remarks	Specimens
427-35	Bahía de Cupica	Shore	Rock	three
239-34	Puerto Utría	Shore	Reef inside outer island	eight
858-38	Puerto Utría	Shore	Rock	eight
414-35	Puerto Utría	3 fms	Coral	one
413-35	Puerto Utría	Shore	Rock	twenty three
232-34	Puerto Utría	Shore	Rock	four
Galapagos Islands				
11-32	Bahía de Conway, Isla Santa Cruz (Indefatigable Island)			fourteen
BARBATIA (BARBATIA) LURIDA (SOWERBY)				
Mexico: Gulf of California				
1737-49	Bahía San Gabriél, Isla Espíritu Santo	1 fm	Coral heads	two
Mexico				
259-34	El Bufadero	15-20 fms	Sand, gravel, mud	one valve
Galapagos Islands				
187-34	Bahía de Cartago, Isla Isabela (Albemarle Island)	8-10 fms	Sand with rock patches	one valve
BARBATIA (CUCULLAEARCA) REEVEANA (ORBIGNY)				
Mexico: Baja California, Pacific coast				
2022-51	10 mi W of Punta Malarrimo	Shore	Rock	four
2024-51	9.5 mi W of Punta Malarrimo	7-9 fms	Rock, sand	one
617-37	Off Punta Pequeña	24 fms	Sand, kelp	one juvenile
Mexico: Gulf of California				
1049-40	Puerto Refugio, Isla Angel de la Guarda	Shore	Rocky reef	three
1053-40	Puerto Refugio, Isla Angel de la Guarda	Shore	Rock	three
533-36	Bahía San Francisquito	40 fms	Sand, kelp	four
1769-49	Punta Aguja, near Punta Concepción	Shore	Rock	three
1772-49	Isla Bargo, Bahía Concepción	Shore	Rocky beach,-0.3′ tide	seven
591-36	Puerto Escondido, S of Loreto	Shore	Shingle	two
742-37	Bahía de San Ignacio, Sinaloa	30-50 fms	Shell	four
518-36	N side, Isla San Francisco	Shore	Rock, sand	two

	Bahía de La Paz			six
Mexico				
268-34	N of Los Frailes Blancos, off Morro de Petatlán	25 fms	Coarse sand	one valve
Costa Rica				
466-35	Puerto Parker, opposite Punta Abajo	Shore, small island at entrance	Rock	two
Panama				
861-38	Bahía Honda	Shore	Rock	two
437-35	Puerto Piñas	Shallow water	Coral	one
Colombia				
435-35	Bahía Octavia	Shallow water	Coral	six
239-34	Puerto Utría	Shore	Reef inside outer island	nine and one valve
859-38	Puerto Utría	Shallow water	Coral	three
419-35	Puerto Utría	Shallow water	Coral	six
414-35	Puerto Utría	3 fms	Coral	two
413-35	Puerto Utría	Shore	Rock	two
411-35	Isla Gorgona	Shallow water	Coral	one
Ecuador				
23-33	Off Isla La Plata	10 fms	Rock, nullipores	two and three valves
Galapagos Islands				
306-35	Isla Marchena (Bindloe Island)	Reef	Lava rock	two
96-33	Bahía de Darwin, Isla Genovesa (Tower Island)	Shallow water	Rock	four
69-33	Punta Albemarle, Isla Isabela (Albemarle Island)	Shore	Rock, tide pools	one
71-33	Bahía de James, Isla Santiago (James Island)	Shore	Rock, sand	two
65-33	N of Cerro Tagus, Isla Isabela (Albemarle Island)	Reef	Rock	two
333-35	W coast of Isla Santiago (James Island)	Shore	Rocky ledges	three
796-38	Bahía de Sulivan, Isla Santiago (James Island)	Shore	Rock	eight
343-35	Bahía de Sulivan, Isla Santiago (James Island)	Shore	Rock	five
178-34	Bahía de Sulivan, Isla Santiago (James Island)	40 fms	Rough rock	one (dead)
175-34	Isla Seymour (North Seymour Island)	Shore	Rock	six

Station	Location	Depth	Remarks	Specimens
85-33	Isla Seymour (North Seymour Island)	Shore	Rock	three
350-35	Isla Baltra (South Seymour Island)	Shore	Rock, sand	six
789-38	Isla Baltra (South Seymour Island)	West shore	Rock, sand	five
173-34	Off Isla Baltra (South Seymour Island)	5 fms	Sand with rock patches	one valve
80-33	Isla Pinzón (Duncan Island)	Shallow water	Coral	three
82-33	Bahía de Conway, Isla Santa Cruz (Indefatigable Island)	Shore of small island	Rock	one
800-38	Bahía de Cartago, Isla Isabela (Albemarle Island)	North shore	Rock	two
188-34	Bahía de Cartago, Isla Isabela (Albemarle Island)	North shore	Rock, sand	two
76-33	Bahía de Cartago, Isla Isabela (Albemarle Island)	North shore	Sand	one
187-34	Bahía de Cartago, Isla Isabela (Albemarle Island)	8-10 fms	Sand with rock patches	one
314-35	Bahía de Academy, Isla Santa Cruz (Indefatigable Island)	Shore	Rock	one
168-34	Bahía de Academy, Isla Santa Cruz (Indefatigable Island)	Shore	Rock	two
170-34	Bahía de Stephens, Isla San Cristóbal (Chatham Island)	32 fms	Fine sand, corallines	many valves
42-33	Bahía de Stephens, Isla San Cristóbal (Chatham Island)	Shore	Rock	two valves
48-33	Isla Santa Fé (Barrington Island)	Shore	Rock	seven
804-38	Isla Onslow, N of Isla Floreana (Charles Island)	Crater	*Pavona* coral	two
38-33	SE of Punta Cormorant, Isla Floreana (Charles Island)	Shore	Rock	two
199-34	Black Beach, Isla Floreana (Charles Island)	Shore	Rock	one
166-34	Black Beach, Isla Floreana (Charles Island)	Shore	Rock	six
351-35	S of Black Beach, Isla Floreana (Charles Island)	Shore	Turnable rocks	one
359-35	Isla Osborn, Bahía de Gardner, Isla Española (Hood Island)	Shore	Rock	two
30-33	Bahía de Gardner, Isla Española (Hood Island)	Shore	Rock	one

24-33	Isla Osborn, Bahía de Gardner, Isla Española (Hood Island)	Shore	Rock	thirteen
27-33	Bahía de Gardner, Isla Española (Hood Island)	Shore	Rock	one
BARBATIA (CALLOARCA) ALTERNATA (SOWERBY)				
Mexico: Gulf of California				
1072-40	Punta Peñasca, Sonora	10 fms	Sand, shell	one valve
1078-40	Bahía de Tepoca, Sonora	11-13 fms	Sandy mud	five valves
1064-40	Off Isla Willard, Bahía de San Luis Gonzaga	10-20 fms	Mud	two valves
715-37	Punta Willard, Bahía de San Luis Gonzaga	Shore		one valve
BS 279	E of Isla Tiburón	16 fms		one valve
1039-40	Bahía de Guaymas, near Cabo Haro, Sonora	6-10 fms	Shell, mud	one valve
BARBATIA (FUGLERIA) ILLOTA (SOWERBY)				
Mexico: Gulf of California				
707-37	Puerto Refugio, Isla Angel de la Guarda	Shore	Rock	one
537-36	Bahía de los Angeles	Shore	Sand	four
1083-40	Isla de San Esteban	Shore	Rock	one
533-36	Punta San Gabriél	40 fms	Sand, broken shell	four
739-37	Ensenada de San Francisco, Sonora	Shore	Shingle	one
1767-49	Vicinity of Puerto San Carlos	Shore	Rocky beach	one
669-37	Off Puerto Escondido, S of Loreto	34 fms	Sand	eight
Mexico				
121-33	Bahía Tenacatita	Shore, head of bay	Rock, sand	one valve
Costa Rica				
465-35	Bahía Playa Blanca	Shore	Shale	one
Colombia				
433-35	Bahía Octavia	Shore, on island	Shingle	one juvenile
232-34	Puerto Utría	Shore	Rock	three
ACAR GRADATA (BRODERIP AND SOWERBY)				
Mexico: Baja California, Pacific coast				
KG 5	Laguna de Scammon	5-9 fms	Shell.	one (fine)
2022-51	10 mi W of Punta Malarrimo	Shore	Rock, reef and tidepools; rich	six ond one valve (fine)
1718-49	Canal de Marcy, Bahía de La Magdalena	13 fms	Dredge. Rock, sea urchins and sponges	one (fine)

Station	Location	Depth	Remarks	Specimens
1713-49	Punta Entrada, Isla Magdalena	Shore	Rocky beach; protected and exposed coastline	one (fine)
Mexico: Gulf of California				
570-36	E of Isla Tiburón	12 fms	Mud	one (coarse)
601-36	Bahía Agua Verde	20 fms	Mud	three (coarse)
BS 2155	Bahía de San José del Cabo	17-25 fms		one valve
2588-54	Isla Isabel	Diving, 0-3 fms	Rock	one (coarse)
749-37	Isla Isabel	Rocky reef	Low tide	one (fine)
124-33	Isla Isabel	Shore	Rock	four (coarse)
Mexico				
2-31	Bahía Tenacatita			three (coarse)
Dawson 126	Inner bay of Acapulco, Guerrero	Shore	Rock	six (coarse)
260-34	El Bufadero	Shore on small island in bay	Rock	two (coarse)
Costa Rica				
466-35	Puerto Parker, opposite Punta Abajo	Shore, small island at entrance	Rock	three (coarse)
Panama				
446-35	Islas Secas	Shore	Rock	one (coarse)
247-34	Bahía Honda	Shallow water	Coral	two (coarse)
Colombia				
433-35	Bahía Octavia	Shore, on island	Shingle	one (coarse)
427-35	Bahía de Cupica	Shore	Rock	one (coarse)
858-38	Puerto Utría	Shore	Rock	one (fine)
239-34	Puerto Utría	Shore	Reef inside outer island	eight (coarse)
413-35	Puerto Utría	Shore	Rock	three (coarse)
232-34	Puerto Utría	Shore	Rock	three (coarse)
411-35	Isla Gorgona	Shallow water	Coral (*Pocillopora*)	one (fine)
Ecuador				
214-34	Off Cabo de San Francisco	2 fms	Mud, rock	many juvenile
850-38	Off Cabo de San Francisco	15 fms	Mud, rock	three (fine)
400-35	Bahía de Manta	Shore	Rock, sand	four (fine)

403-35	W of Manta	Reef with breakers		one (fine)
BS 502	Bahía de Santa Elena, off Salinas	15 fms		many juvenile
10-33	La Puntilla	Shore	Rock	nine (coarse and fine)
12-33	Bahía de Santa Elena, off beach	4 fms	Sand	four (fine)
Galapagos Islands				
306-35	Isla Marchena (Bindloe Island)	Reef	Lava rock	one (coarse)
782-38	Bahía de Darwin, Isla Genovesa (Tower Island)	Shore	Rock	one (fine)
101-33	Bahía de Darwin, Isla Genovesa (Tower Island)	Shore	Rock	one (coarse)
96-33	Bahía de Darwin, Isla Genovesa (Tower Island)	Shallow water	Rock	one (coarse)
69-33	Punta Albemarle, Isla Isabela (Albemarle Island)	Shore	Rock, tide pools	six (coarse)
71-33	Bahía de James, Isla Santiago (James Island)	Shore	Rock, sand	one (coarse)
333-35	West coast of Isla Santiago (James Island)	Shore	Rocky ledges	four (coarse and fine)
796-38	Bahía de Sulivan, Isla Santiago (James Island)	Shore	Rock	one (coarse)
343-35	Bahía de Sulivan, Isla Santiago (James Island)	Shore	Rock	thirty one (coarse)
85-33	Isla Seymour (North Seymour Island)	Shore	Rock	two (fine)
789-38	Isla Baltra (South Seymour Island)	West shore	Rock, sand	one (coarse)
350-35	Isla Baltra (South Seymour Island)	Shore	Rock, sand	one (fine)
173-34	Off Isla Baltra (South Seymour Island)	5 fms	Sand with rock patches	ten valves (coarse)
82-33	Bahía de Conway, Isla Santa Cruz (Indefatigable Island)	Shore of small island	Rock	two (fine)
11-32	Bahía de Conway, Isla Santa Cruz (Indefatigable Island)			four and a half (coarse)
800-38	Bahía de Cartago, Isla Isabela (Albemarle Island)	North shore	Rock	four (coarse and fine)
187-34	Bahía de Cartago, Isla Isabela (Albemarle Island)	8-10 fms	Sand with rock patches	one valve (fine)
170-34	Bahía de Stephens, Isla San Cristóbal (Chatham Island)	32 fms	Fine sand, coralline	one valve (fine)
48-33	Isla Santa Fé (Barrington Island)	Shore	Rock	seven (coarse)
806-38	Black Beach, Isla Floreana (Charles Island)	Shore	Rock	one (coarse)
166-34	Black Beach, Isla Floreana (Charles Island)	Shore	Rock	five (coarse)

Station	Location	Depth	Remarks	Specimens
359-35	Isla Osborn, Bahía de Gardner, Isla Española (Hood Island)	Shore	Rock	thirty six (coarse)
202-34	Isla Osborn, Bahía de Gardner, Isla Española (Hood Island)	Shore	Rock	seventeen (coarse)
24-33	Isla Osborn, Bahía de Gardner, Isla Española (Hood Island)	Shore	Rock	eight (coarse)
27-33	Bahía de Gardner, Isla Española (Hood Island)	Shore	Rock	twenty (coarse)
Peru				
847-38	9½ mi SW of Zorritos Light	Shore	Rock	one (fine)
ACAR BAILYI BARTSCH				
California				
W.K. Emerson	La Jolla			five
Mexico: Baja California, Pacific coast				
BS 224	Islas San Benito	13 fms		one valve
22-32	Bahía del Tortuga			two
Mexico: Gulf of California				
1049-40	Puerto Refugio, Isla Angel de la Guarda	Shore	Rocky reef	one
BS 275	Isla Raza	40 fms		one valve
591-36	Puerto Escondido, S of Loreto	Shore	Shingle	one
749-37	Isla Isabel	Rocky reef	Low tide	one
19-32	Isla Isabel			two
2601-54	Lagoon behind NE Point, Isla María Cleofas, Las Tres Marías	Shore	Loose rock, sand	thirteen
Mexico				
274-34	Off south entrance to Bahía Tenacatita	50 fms	Mud, sand	ten
133-34	Bahía Braithwaite, Isla Socorro	20 fms	Sand	one valve
141-34	Bahía Sulphur, Isla Clarión	Shore	Shingle	one
140-34	Bahía Sulphur, Isla Clarión	Shallow water	Coral	many
Costa Rica				
256-34	S of Punta Mala	Shore	Rock	eleven
258-34	Off Bahía Cocos	Shallow water	Coral	seven

Panama				
867-38	Islas Secas	Shallow water	Coral	many
866-38	Islas Secas	Shore	Rock	five
447-35	Islas Secas	Shallow water	Coral	fourteen
252-34	Islas Secas	Shallow water	Coral	eight
446-35	Islas Secas	Shore	Rock	two
247-34	Bahía Honda	Shallow water	Coral	thirteen
114-33	Bahía Honda	Shallow water	Coral	two
Galapagos Islands				
782-38	Bahía de Darwin, Isla Genovesa (Tower Island)	Shore	Rock	many
96-33	Bahía de Darwin, Isla Genovesa (Tower Island)	Shallow water	Rock	four
65-33	N of Cerro Tagus, Isla Isabela (Albemarle Island)	Reef	Rock	one
350-35	Isla Baltra (South Seymour Island)	Shore	Rock, sand	three
173-34	Off Isla Baltra (South Seymour Island)	5 fms	Sand with rock patches	seven valves
88-33	Isla Baltra (South Seymour Island)	West shore	Rock, sand	seven
82-33	Bahía de Conway, Isla SantaCruz (Indefatigable Island)	Shore of small island	Rock	two
11-32	Bahía de Conway, Isla SantaCruz (Indefatigable Island)			many
188-34	Bahía de Cartago, Isla Isabela (Albemarle Island)	North shore	Rock, sand	many
170-34	Bahía de Stephens, Isla San Cristóbal (Chatham Island)	32 fms	Fine sand, coralline	one (dead)
ACAR PUSILLA (SOWERBY)				
Ecuador				
22-33	Isla La Plata	Shore		seven
ARCOPSIS SOLIDA (SOWERBY)				
California				
1271-41	¾ mi SE of Cat Rock, Anacapa Island	23-25 fms	Coralline, gray coarse sand	four valves. Ballast?*
Mexico: Baja California, Pacific coast				
1257-41	3 mi NW of Isla Natividad	30-31 fms	Coarse sand, sponge-covered rock	one and a half (dead)

*See same number in the list of *A. pacifica.*

Station	Location	Depth	Remarks	Specimens
2022-51	10 mi W of Punta Malarrimo	Shore	Rock, reef, tide pools; rich	six
1956-50	Punta Abreojos	Shore	Rock, conglomerate shelf, few tide pools	one
617-37	Off Punta Pequeña	24 fms	Sand, kelp	one
1713-49	Punta Entrada, Bahía de la Magdalena	Shore	Rocky beach, protected and exposed coastline	seven
1719-49	E shore of Isla Santa Margarita	Shore	Sand, rock	four
Mexico: Gulf of California				
1075-40	Inside Isla Jorge	12-13 fms	Sand, shell	one
719-37	Off Rocas Consag	10-25 fms	Basket stars	one
1077-40	Bahía de Tepoca, Sonora	Shore	Rock, reef	six
1063-40	Isla Willard, Bahía de San Luis Gonzaga	Shore	Shingle	two and one valve
707-37	Puerto Refugio, Isla Angel de la Guarda	Shore	Rock	one
713-37	Puerto Refugio, Isla Angel de la Guarda	Shore	Rock	three and one valve
1049-40	Puerto Refugio, Isla Angel de la Guarda	Shore	Rocky reef	many
1053-40	Puerto Refugio, Isla Angel de la Guarda	Shore	Rock	ten
1079-40	Isla Pond, Isla Angel de la Guarda	Shore	Rock	twenty two
700-37	Bahía de Los Angeles	Shore	Shingle	two
BS 279	E of Isla Tiburón	16 fms		one valve
BS 277	Isla Tiburón	16 fms		one valve
1042-40	Isla Turner, S of Isla Tiburón	Shore	Rocky reef	eight
1083-40	Isla de San Esteban	Shore	Rock	eight
1091-40	Puerto San Carlos, Sonora	Shore	Shingle	thirty four
739-37	Ensenada de San Francisco, Sonora	Shore	Shingle	many
1766-49	Puerto San Carlos, Sonora	Shore	Enclosed harbor	sixteen
1767-49	Vicinity of Puerto San Carlos, Sonora	Shore	Rocky beach	four
1515-46	Ensenada Bocochibampo, Guaymas	Mud flats and sandy estuary		four
1514-46	Ensenada Bocochibampo, Guaymas	Shore	Rock	fourteen
1040-40	Bahía de Guaymas, Sonora	Shore	Rock	one
1041-40	Bahía de Guaymas, Sonora	Shore	Shingle	two
1092-40	Bahía Catalina, near Cabo Arco, Sonora	Shore	Shingle	fifteen
682-37	Off Bahía Concepción	12 fms	*Strombus* shell	one
1769-49	Punta Aguja, near Punta Concepción	Shore	Rocky, tide pool	one
1772-49	Isla Bargo, Bahía Concepción	Shore	Rocky beach, sponges, crabs. -0.3′ tide	three

591-36	Puerto Escondido, S of Loreto	Shore	Shingle	eighteen
593-36	Puerto Escondido, S of Loreto	5 fms	Mud, shell	one
1749-49	East shore, Puerto Escondido, S of Loreto	Shore	Rock. Skiff used. Sponges	two
669-37	Off Puerto Escondido	34 fms	Sand	seventeen
1104-40	Bahía de Agua Verde	Shore	Rock	one
522-36	Bahía de Agua Verde	Shore	Reef	one
742-37	Bahía de San Ignacio, Sinaloa	30-50 fms	Shell	one
518-36	North side, Isla San Francisco	Shore	Rock, sand	twenty three
1737-49	Bahía San Gabriél, Isla Espíritu Santo	1 fm	Coral heads containing crabs and shrimp	two
623-37	Cabeza Ballena	Shore	Rock, tide pools	many
1784-49	Bahía de San Lucas	Shore	Loose rock over sand	eight
Costa Rica				
466-35	Puerto Parker, opposite Punta Abajo	Shore, small island at entrance	Rock	one
Panama				
860-38	8 mi E of Panama City	Shore	Rock	two
14-32	Balboa, Canal Zone			one
439-35	Puerto Piñas	20 fms	Mud, sand	one
Galapagos Islands				
154-34	Reef north of Cerro Tagus, Isla Isabela (Albemarle Island)	Reef	Rock	one
157-34	Ensenada Tagus, Isla Isabela (Albemarle Island)	10-18 fms	Sand, shell	one
350-35	Isla Baltra (South Seymour Island)	Shore	Rock, sand	one
173-34	Off Isla Baltra (South Seymour Island)	5 fms	Sand with rock patches	many valves
82-33	Bahía de Conway, Isla Santa Cruz (Indefatigable Island)	Shore of small island	Rock	one
11-32	Bahía de Conway, Isla Santa Cruz (Indefatigable Island)			five
187-34	Bahía de Cartago, Isla Isabela (Albemarle Island)	8-10 fms	Sand with rock patches	many

Station	Location	Depth	Remarks	Specimens
59-33	Off Punta Cormorant, Isla Floreana (Charles Island)	13 fms	Rock	one
196-34	Bahía del Correo, Isla Floreana (Charles Island)	8-10 fms	Rough rock	one valve
166-34	Black Beach, Isla Floreana (Charles Island)	Shore	Rock	one
ANADARA (ANADARA) TUBERCULOSA (SOWERBY)				
Costa Rica				
474-35	Bahía de Salinas	Shore	Sandstone	one
ANADARA (LARKINIA) GRANDIS (BRODERIP AND SOWERBY)				
Mexico				
	Ensenada, Baja California			one
Panama				
Acc. no. 1095	Isla Taboga, collected by Helen Hoyt	Shore		one valve
ANADARA (LARKINIA) MULTICOSTATA (SOWERBY)				
Mexico: Gulf of California				
1072-40	Punta Peñasca, Sonora	11 fms	Mud, sand	one
1056-40	Between Isla Angel de la Guarda and Isla Mejía	6-11 fms	Sand, coralline	one
559-36	S of Isla Partida	45 fms	Sand	one juvenile
1044-40	S of Isla Tiburón	2-16 fms	Sand. Beam trawl	one large
531-36	Bahía San Francisquito	10 fms	Sand, kelp, algae	one
1516-46	Ensenada de San Francisco	Reefs	Tide pools	two valves
1088-40	Ensenada de San Francisco	2-6 fms	Sand. Beam trawl	two
576-36	S of Isla Tortuga	21 fms	Volcanic sand	one
526-36	S of Punta Mangles	3-5 fms	Sand, seaweed	two juvenile
669-37	Off Puerto Escondido, S of Loreto	34 fms	Sand	one
1740-49	Bahía de Agua Verde	Shore	Rocky beach	one
642-37	Bahía de Ballenas, Isla Espíritu Santo	25 fms	Coralline	one
1112-40	Bahía San Gabriél, Isla Espíritu Santo	Shore	Shingle, tide pools at stone pits	one valve
606-36	Canal de San Lorenzo	14 fms	Sand	one
1111-40	Canal de San Lorenzo	6-13 fms	Sand, shell, coralline	one valve

Galapagos Islands				
183-34	Between Isla Albany and Isla Santiago (James Island)	50-70 fms	Rock, shell	one
182-34	Off Bahía de James, Isla Santiago (James Island)	30 fms	Coarse sand	one valve
328-35	Ensenada Tagus, Isla Isabela (Albemarle Island)	14 fms	Sand, nullipores	one
790-38	Isla Baltra (South Seymour Island)	10-20 fms	Sand, rock	one
347-35	Off Isla Seymour (N. Seymour Island)	3 fms	Sand, rock, shell	eight small
799-38	Bahía de Cartago, Isla Isabela (Albemarle Island)	15-18 fms	Sand	one
816-38	N of Isla Española (Hood Island)	50-100 fms	Rock, sand	one
ANADARA (SCAPHARCA) REINHARTI (LOWE)				
Mexico: Gulf of California				
719-37	Off Rocas Consag	10-25 fms	Basket stars	one juvenile
1078-40	Bahía de Tepoca, Sonora	11-13 fms	Sandy mud, sand, shell	one juvenile
714-37	Off Punta Willard, Bahía de San Luis Gonzaga	16-30 fms	Rock, mud	three valves
1064-40	Off Isla Willard, Bahía de San Luis Gonzaga	10-20 fms	Mud	one and three valves
1087-40	Ensenada de San Francisco	15-18 fms	Sand	one juvenile
526-36	S of Punta Mangles	3-5 fms	Sand, seaweed	one
1747-49	Puerto Escondido, S of Loreto	7 fms		one
1096-40	Puerto Escondido, S of Loreto	18-21 fms	Sand, cake urchins	fourteen
656-37	Bahía de Agua Verde	25 fms	Mud	one
Mexico				
2596-54	Bahía de Santa Lucía, Acapulco, Guerrero	1-4 fms	Diving. Rock, mud, sand	one, length 75 mm
Costa Rica				
471-35	Off Punta Abajo	10 fms	Mud	one
116-33	Bahía Cocos	2 fms	Sand, shell	ten juvenile
773-38	Off Isla de la Nuez, Isla del Coco	31-50 fms	Coralline	thirty two large
780-38	Bahía de Chatham, Isla del Coco	40-47 fms	Coarse white sand	two large
Panama				
960-39	Isla Taboga	2-5 fms	Sand, coralline	two
Ecuador				
399-35	Isla Salango	8 fms	Sand	one juvenile

Station	Location	Depth	Remarks	Specimens
209-34	Off Bahía de Santa Elena	8-10 fms	Rock, large shells, gorgonids	five
ANADARA (SCAPHARCA) CUMINGIANA (NYST)				
Mexico: Gulf of California				
BS 2043	31° 12′ N, 114° 01′ 30″ W	34 fms		one valve
1061-40	Off Punta Willard, Bahía de San Luis Gonzaga	30-40 fms	Mud	one
BS 2038	Bahía de San Luis Gonzaga	11 fms		sixteen valves
BS 2054	27° 03′ N, 110° 10′ W	32 fms		one valve
BS 2025	Mouth of Bahía Concepción	30 fms		three valves
656-37	Bahía de Agua Verde	25 fms	Mud	one
Costa Rica				
253-34	Boca de Culebra	10 fms	Mud, shell	four valves
Ecuador				
396-35	Isla Salango	12 fms	Rock, sand	one
ANADARA (SCAPHARCA) BIANGULATA (SOWERBY)				
Mexico: Gulf of California				
BS 2124	Punta San Felipe	5 fms		eight valves
BS 2030	Bahía de Los Angeles	30 fms		one valve
BS 2017	Off Puerto Escondido, S of Loreto	20 fms		two valves
BS 2145	NW of Isla de San Gabriél	29-35 fms		one valve
BS 2012	Bahía San Gabriél, Isla Espíritu Santo	24 fms		five valves
BS 2013	W of Canal de San Lorenzo	30 fms		two valves
BS 248	Off S end of Isla Espíritu Santo	24 fms		four valves, one valve fresh
Mexico				
870-38	Isla Isabel	10-15 fms	Coralline, gorgonids	one
Panama				
244-34	S of Isla Medidor, off Bahía Honda	30-35 fms	Coarse sand, shell, mud	sixteen valves
ANADARA (SCAPHARCA) AVICULAEFORMIS (NYST)				
Mexico				
870-38	Isla Isabel	10-15 fms	Coralline, gorgonids	one

Panama				
457-35	Islas Secas	12 fms	Sand, rock	one
ANADARA (SCAPHARCA) EMARGINATA (SOWERBY)				
Mexico				
1718-49	Canal de Marcy, Bahía de la Magdalena, Baja California	13 fms	Rock	four
Ecuador				
9-33	Bahía de Santa Elena	3-5 fms	Sand	one and one valve
ANADARA (SCAPHARCA) OBESA (SOWERBY)				
Guatemala				
930-39	Off San José Light	12-13 fms	Fine black sand	four
ANADARA (CUNEARCA) NUX (SOWERBY)				
Mexico				
964-39	Bahía Tenacatita	2-8 fms	Mud	two
965-39	Bahía Tenacatita	8-15 fms	Shell, sand	one
121-33	Bahía Tenacatita	Shore, head of bay	Rock, sand	three and one valve
868-38	Off Acapulco	11 fms	Fine sand	one
927-39	Outside Laguna de Chacahua	10-15 fms	Mud	two
259-34	El Bufadero	15-20 fms	Sand, gravel, mud	many
Guatemala				
929-36	Near San José Light	2-5 fms	Fine sand	two
930-39	Off San José Light	12-13 fms	Fine black sand	forty
770-38	Off San José	7-11 fms	Black sand	twenty one
Costa Rica				
476-35	Bahía de Salinas	8 fms	Mud	one
477-35	Bahía de Salinas	2 fms	Coarse sand	one
468-35	Puerto Parker, near Punta Abajo	5 fms	Sand, shell	one
253-34	Boca de Culebra	10 fms	Mud, shell	three, many valves
257-34	Bahía Cocos	10 fms	Sand, shells	two
116-33	Bahía Cocos	2 fms	Sand, shell	many juveniles
939-39	Golfo Dulce	10-22 fms	Coarse sand	one
Colombia				
417-35	Puerto Utría	10 fms	Mud	one valve

Station	Location	Depth	Remarks	Specimens
Ecuador				
215-34	Ensenada de San Francisco	2 fms	Mud, debris	two
850-38	Off Cabo de San Francisco	15 fms	Mud, rock	one
402-35	Bahía de Manta	1 fm	Sand	ten
397-35	Isla Salango	3 fms	Sand	two
15-33	Bahía de Santa Elena, off Salinas	10 fms	Sand, shell	three
209-34	Bahía de Santa Elena	8-10 fms	Rock, large shells, gorgonids	two
210-34	Bahía de Santa Elena, near south shore	5-7 fms	Rocks, shells, gorgonids	one
9-33	Bahía de Santa Elena, off Salinas	3-5 fms	Sand	seven
ANADARA (CUNEARCA) AEQUATORIALIS (ORBIGNY)				
Guatemala				
770-38	Off San José	7-11 fms	Black sand, mud, shell	two
LUNARCA VESPERTINA (MÖRCH)				
Mexico: Baja California, Pacific coast				
617-37	Off Punta Pequeña	24 fms	Sand, kelp	one
Mexico: Gulf of California				
638-37	Bahía San Gabriél, Isla Espíritu Santo	Shallow water	Coral	two
632-37	Bahía San Gabriél, Isla Espíritu Santo	24 fms	Sandy mud	one
LUNARCA SP.				
Panama				
Jan. 1937				one
Galapagos Islands				
BS 456	Isla Marchena	20 fms		one valve
BS 461	Ensenada Tagus, Isla Isabela (Albemarle Island)	80 fms		one valve
NOETIA REVERSA (SOWERBY)				
Mexico: Gulf of California				
682-37	Off Bahía Concepción	12 fms	*Strombus* shells	one
632-37	Bahía San Gabriél, Isla Espíritu Santo	24 fms	Sandy mud	two juvenile
Mexico				
763-38	Cabo Corrientes	5-10 fms	Broken shell	one juvenile

121-33	Bahía Tenacatita	Shore, head of bay	Rock, sand	two juvenile
868-38	Off Acapulco	11 fms	Fine sand	three
927-39	Outside Laguna de Chacahua	10-15 fms	Mud	twelve juvenile
765-38	Outside Laguna de Chacahua	5-10 fms	Nullipores	two juvenile
Nicaragua				
962-39	11 mi NW of Corinto	1-3 fms	Sand, dead leaves	one
Colombia				
434-35	Bahía Octavia	2 fms		one juvenile
SHELDONELLA DELGADA (LOWE)				
Mexico: Gulf of California				
BS 2057	Bahía de San Ignacio, Sinaloa	23 fms		two valves
Mexico				
274-34	Entrance to Bahía Tenacatita	50 fms	Mud, sand	one and one valve
Panama				
BS 342	Islas Secas	25-26 fms		one and one valve
244-34	Isla Medidor, off Bahía Honda	30-35 fms	Coarse sand, shell, mud	five valves

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PLATES

PLATE 11

Fig. 1. *Arca mutabilis* (Sowerby) 1833. Puerto Parker, Costa Rica. Dorsal view showing narrow ligamental area. Length, 30 mm.

Fig. 2. *Arca mutabilis* (Sowerby) 1833. Isla Isabel, Gulf of California. Dorsal view showing very wide ligamental area. Length, 32 mm.

Fig. 3. *Barbatia lurida* (Sowerby) 1833. Isla Espíritu Santo, Gulf of California. a. Outside of right valve. b. Inside of the same. Length, 28.7 mm.

Fig. 4. *B.* (*Cucullaearca*) *reeveana* (Orbigny) 1846. Isla Angel de la Guarda, Gulf of California. Detail of periostracum. Length, 70 mm.

Fig. 5. *B.* (*Cucullaearca*) *reeveana* (Orbigny) 1846. Off Punta Pequeña, Baja California. a. Outside of right valve of young specimen. b. Dorsal view of the same. Note that the ligament is behind the umbones. Length, 10.3 mm.

Fig. 6. *B.* (*Fugleria*) *illota* (Sowerby) 1833. Puerto Utría, Colombia. Inside of left valve. Note the obsolete teeth in the middle of the hinge. Length, 38.1 mm.

Fig. 7. *B.* (*Fugleria*) *illota* (Sowerby) 1833. Off Puerto Escondido, Gulf of California. Inside of left valve. Note the more ovate form. Length, 23 mm.

Fig. 8. *B.* (*Fugleria*) *illota* (Sowerby) 1833. Bahía Octavia, Colombia. Hinge of young specimen with continuous row of teeth. Length, 13.2 mm.

Fig. 9. *B.* (*Cucullaearca*) *reeveana* (Orbigny) 1846. Isla Wenman, Galapagos Islands. Young specimen with yellow prodissoconch. Length, 2.7 mm.

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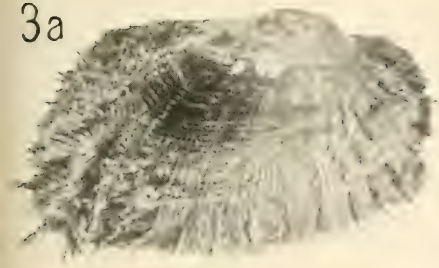
3a



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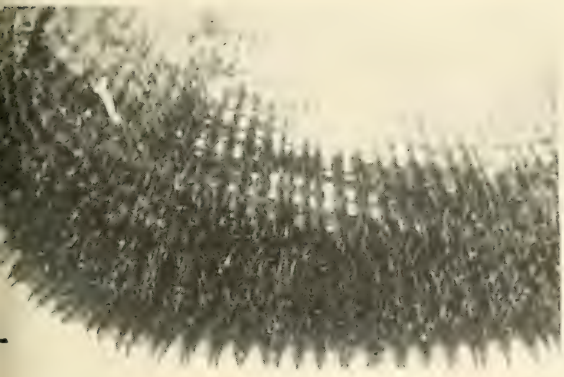

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PLATE 12

Fig. 10. *Arcopsis solida* (Sowerby) 1833. Bahía de Cartago, Albemarle Island, Galapagos Islands. Young specimen showing sculpture similar to that of the genus *Acar*. Length, 5 mm.

Fig. 11. *Acar gradata* (Broderip and Sowerby) 1829. Isla Isabel, Gulf of California. Outside of right valve of young specimen. Coarsely sculptured form. Length, 10.2 mm.

Fig. 12. *Acar gradata* (Broderip and Sowerby) 1829. Off Cabo de San Francisco, Ecuador. Outside of right valve of young specimen. Finely sculptured form. Length, 9 mm.

Fig. 13. *Acar pusilla* (Sowerby) 1833. Isla La Plata, Ecuador. Outside of left valve. Length, 7 mm.

Fig. 14. *Acar bailyi* Bartsch 1931. (*forma insularis*). Islas Secas, Panama. Outside of left valve. Length, 10.2 mm.

Fig. 15. *Acar bailyi* Bartsch 1931. (*forma insularis*). Islas Secas, Panama. a. Dorsal view. b. Outside of right valve. c. Inside of right valve. d. Outside of left valve. e. Inside of left valve. Length, 9 mm.

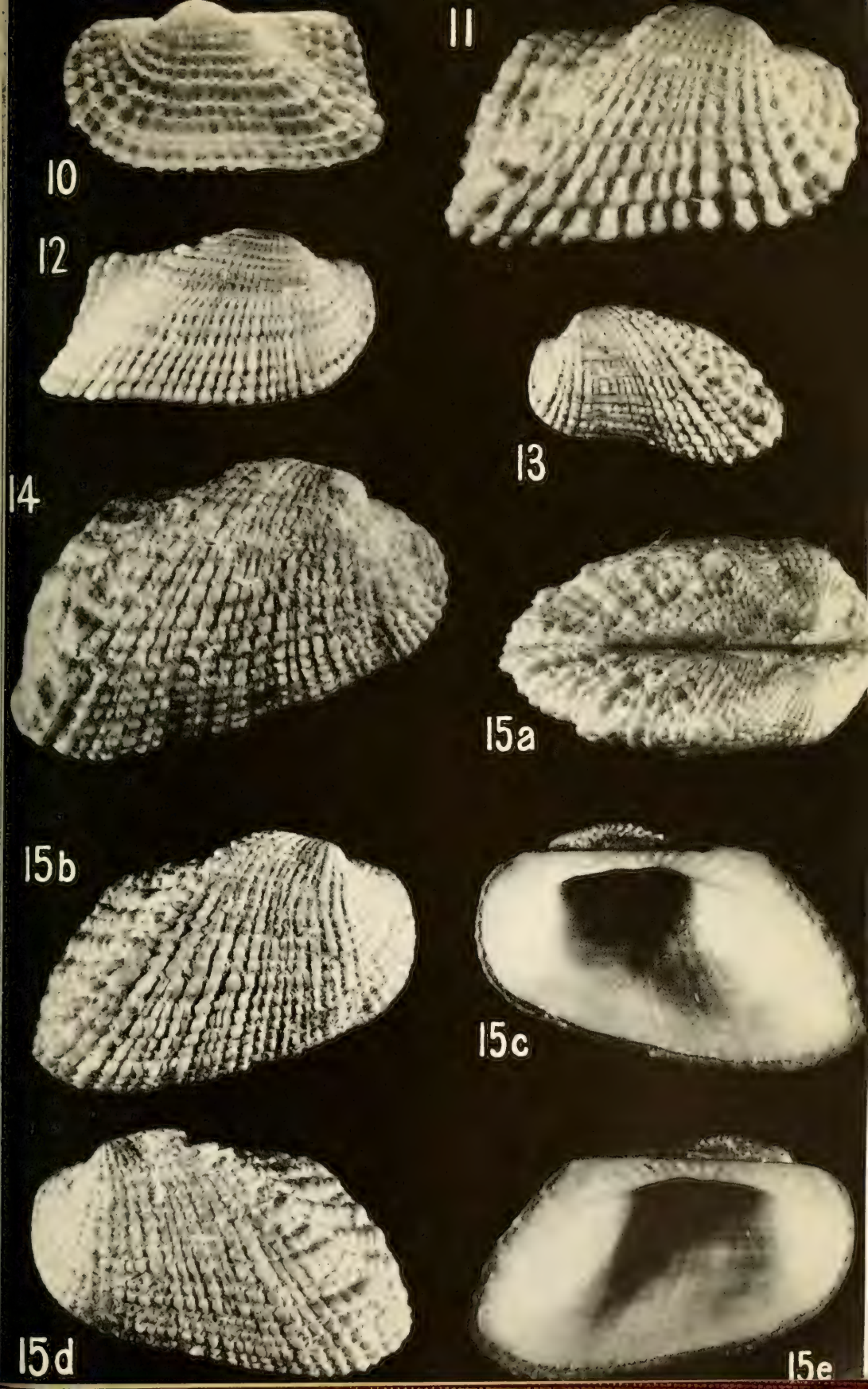
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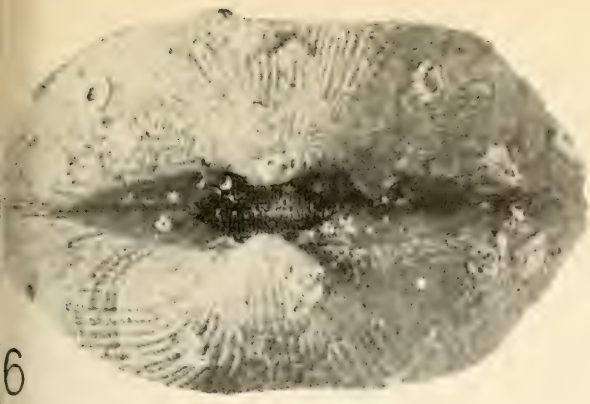
PLATE 15

Fig. 16. *Arcopsis solida* (Sowerby) 1833. Puerto San Carlos, Sonora, Gulf of California. Dorsal view to show ligament. Note the transverse striations. Length, 17.2 mm.

Fig. 17. *Anadara tuberculosa* (Sowerby) 1833. Bahía de Salinas, Costa Rica. a. Outside of right valve. b. Dorsal view. Length, 56 mm.

Fig. 18. *A.* (*Scapharca*) *reinharti* (Lowe) 1935. Puerto Escondido, Gulf of California. a. Outside of right valve. b. Outside of of left valve. c. Dorsal view.

Fig. 19. *Anadara* cf. *reinharti* (Lowe) 1935. Bahía de Santa Lucía, Acapulco, Guerrero, Mexico. a. Outside of right valve. b. The same from inside. Length, 74 mm.



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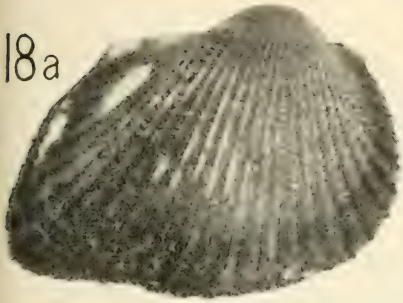

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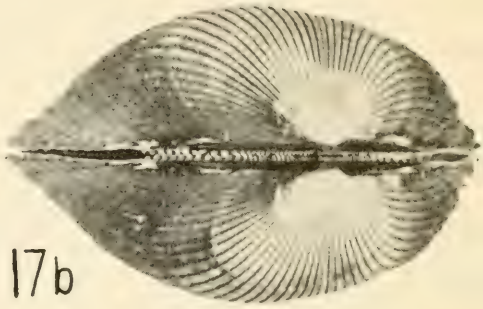

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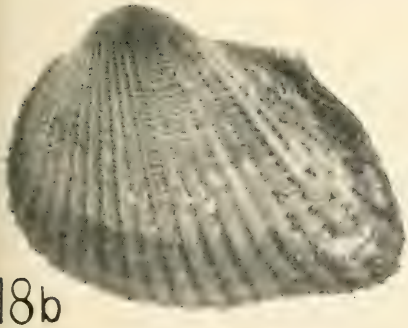

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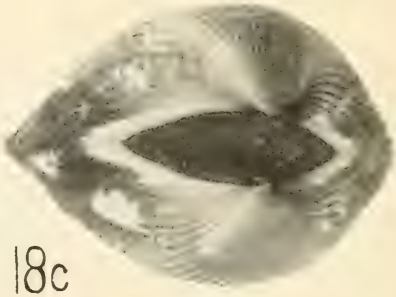

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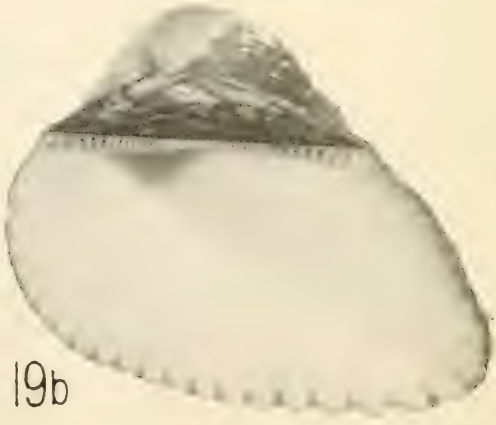

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PLATE 14

Fig. 20. *Anadara* (*Scapharca*) *reinharti* (Lowe) 1935. Bahía de Chatham, Isla del Coco, Costa Rica. a. Outside of left valve. b. Dorsal view. c. Hinge. Length, 43 mm.

Fig. 21. *A.* (*Scapharca*) *aviculaeformis* (Nyst) 1848. Isla Isabel, Gulf of California. a. Outside of left valve. b. Dorsal view. c. Inside of left valve. Length, 54.5 mm.

Fig. 22. *A.* (*Scapharca*) *emarginata* (Sowerby) 1833. Canal de Marcy, Bahía de la Magdalena, Baja California. Outside of left valve. Young specimen. Length, 11.5 mm.

Fig. 23. *A.* (*Scapharca*) *aviculaeformis* (Nyst) 1848. Islas Secas, Panama. Inside of left valve. Length, 34.6 mm.

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20b

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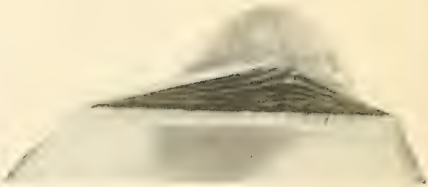

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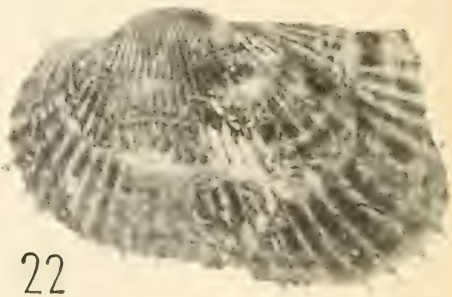

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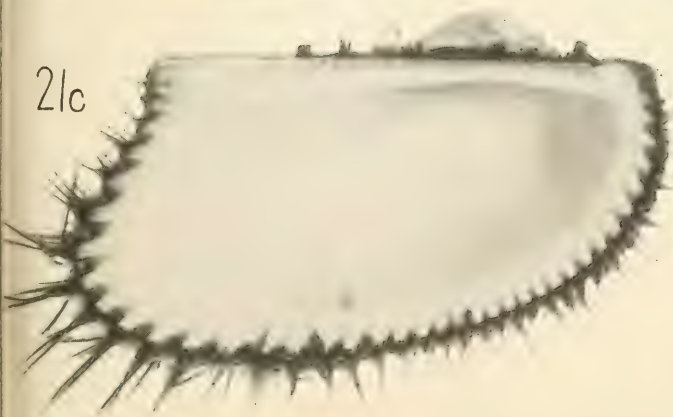

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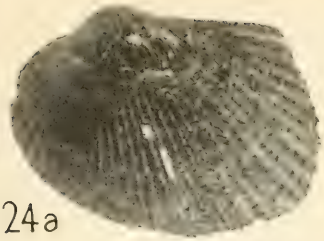
PLATE 15

Fig. 24. *Lunarca vespertina* (Mörch) 1861. Off Punta Pequeña, Baja California. a. Outside of left valve. b. Inside of the same. Length, 17.2 mm.

Fig. 25. *Lunarca* sp. Panama. a. Outside of left valve. b. Inside of the same. Length, 53 mm.

Fig. 26. *Lunarca* sp. Isla Marchena, Galapagos Islands. Outside of right valve. Length, 45.7 mm.

Fig. 27. *Anadara* (*Cunearca*) *aequatorialis* (Orbigny) 1846. Off San José, Guatemala. a. Dorsal view of young specimen. b. Outside of right valve, both valves together. c. Outside of left valve. Length, 14 mm.



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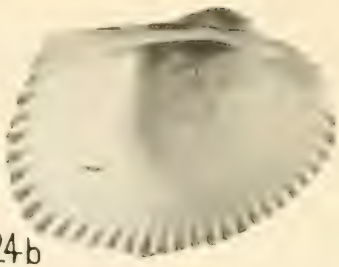

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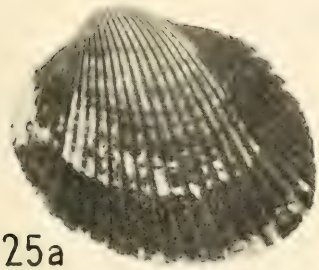

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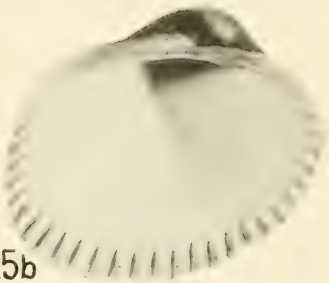

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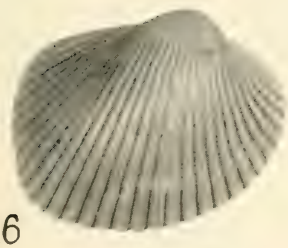

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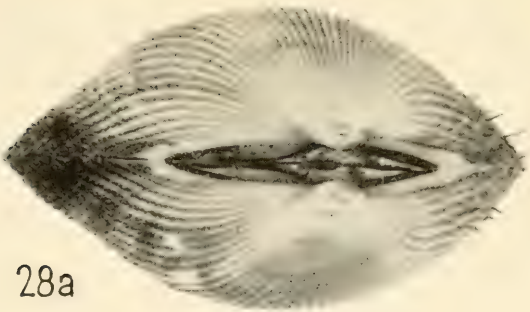
PLATE 16

Fig. 28. *Anadara* (*Scapharca*) *obesa* (Sowerby) 1833. Off San José, Guatemala. a. Dorsal view. b. Outside of left valve. Length, 26.3 mm.

Fig. 29. *A.* (*Cunearca*) *nux* (Sowerby) 1833. Off San José, Guatemala. a. Outside of right valve. b. Outside of left valve. c. Dorsal view. Length, 20.2 mm.



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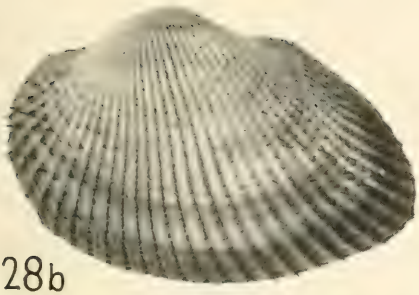

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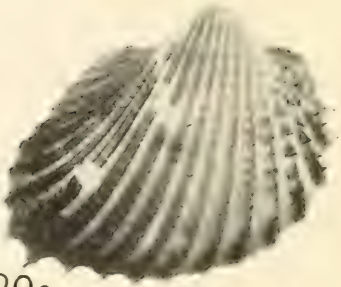

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